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The Bristol-Myers Report: Medicine in the Next Century

A Study Conducted For Bristol-Myers Company By Louis Harris and Associates, Inc.

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THE BRISTOL-MYERS REPORT:
MEDICINE IN THE NEXT CENTURY

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INTRODUCTION

Today as the 21st Century approaches, biomedical science stands on the frontier of a new era. This survey leaves no doubt that medical research is at the threshold of many new and useful discoveries. It is acquiring knowledge and exploring techniques that by the year 2000 and beyond will change the way we prevent, detect and treat disease.

Looking at that frontier, 227 world class research scientists were interviewed during the late summer and fall of 1986 by Louis Harris and Associates as part of a study commissioned by Bristol-Myers to examine priorities and promising areas of medical research in "The Next Century". A complete list of those interviewed can be found on page 199 at the end of this report.

Those interviewed include world leaders in the fields of cancer, cardiovascular disease, central nervous system disorders, infectious disease, biotechnology, nutrition and medical implants.

This new research is designed to give experts, policy-makers and the lay public a better understanding of what the future may hold. It also shows the interrelationship of several key areas of research, and conveys a sense of the excitement felt by many of the scientists about the benefits which they believe will flow from their work.

The survey looks at key issues that cut across all areas of specialty as well as those specific to each of the seven major areas. In particular, the study explores the views and expectations of some of the most eminent medical scientists regarding:

- The leading health problems in the developed and the developing countries in the year 2000.
- What the top research priority in the United States should be between now and the end of the century.

- Diseases or conditions which could be eliminated by the year 2000.
- The most promising research areas.
- The most important fundamental questions in basic research.
- The biggest frustration facing scientists over the next thirteen years.
- Improvements and advances in the prevention, diagnosis, and treatment of a wide range of conditions by the year 2000.
- The medical impact of genetic engineering.
- The status of AIDS in the year 2000.
- Life expectancy in the year 2000 and limits to the human life span.
- Issues relating specifically to each of the seven disciplines.

The Sample of Scientists

The 227 scientists were interviewed between July and November 1986. Most of the scientists were interviewed by telephone; a small minority were interviewed in person or chose to complete the questionnaire by mail.

Most surveys, including those conducted by the Harris firm, are based on interviews with representative samples of particular publics or groups, with probability sampling used to minimize errors and ensure that the findings are projectable. This survey does not use that approach. It presents the opinions and expectations of a select group of scientists, all leaders in their fields.

Any selection of leaders in any field is inevitably subjective. For this survey, a number of leading scientific figures in each of the seven fields were asked to name the individuals they considered to be preeminent in those areas. A total of 387 were nominated of whom 227 were interviewed. Because these people were selected as individuals and not as being representative of any larger group, the survey findings represent the views of the leading scientists interviewed and not necessarily of anyone else.

The Questionnaires

The questionnaires contained three categories of questions: (1) a set of common questions -- asked of all 227 scientists, regardless of their particular discipline; (2) a set of generic questions which shared the same objectives, but applied differently to each of the seven disciplines; and (3) a set of questions which were unique to a particular discipline -- asked only of scientists representing that discipline. Both structured and open-ended questions were included. A copy of the questionnaires may be obtained on request from Louis Harris and Associates.

The survey data for the common questions were weighted to give equal weights to the scientists in each of the seven disciplines.

In designing the survey, it was recognized that the scientists were being asked to make judgments in areas which are subject to a great deal of uncertainty. Some of the scientists interviewed stressed the difficulties of making predictions about the future of medical research and were somewhat reluctant to give precise answers about the future where precision is not possible. Scientists' answers are not presented in this report because they are infallible or because they can predict the future with any certainty, but because the opinions, priorities and expectations of 227 of the world's leading medical scientists in areas of their own expertise merit the careful attention of other scientists, of policy-makers and, indeed, of everyone interested in the future of medicine.

A Note on the Tables

Percentages in the tables may not add to 100% because of rounding or the acceptance of multiple responses.

It should also be noted that a small number of scientists did not answer all the questions; therefore, base numbers may differ.

Acknowledgements

Louis Harris and Associates is indebted to Bristol-Myers Company for making this research possible.

Louis Harris and Associates is also extremely grateful to the scientists who participated in this survey, all of whom gave generously of their time and their help.

Final responsibility for the design and the implementation of the survey and for the findings and conclusions contained in this report rests with Louis Harris and Associates.

HIGHLIGHTS OF THE SURVEY

The views of leading medical scientists, published here, suggest that physicians in the 21st Century will find themselves increasingly empowered to attack disease at its roots rather than just minister to its symptoms.

Many of the scientists who participated in the study identify the new frontier for medical research in the next century: The fundamental understanding of cell mechanism -- how life and disease function at the cell level. However, while many recommend that basic research remain the top priority between now and the year 2000, they also see remarkable medical advances in the prevention, diagnosis and treatment of many diseases between now and then.

This summary provides an overview of some of the results of the survey. Many findings described in the body of the report do not appear in this summary. Interested readers are urged to examine the body of the report to understand the full findings of this research.

1. THE WORLD IN THE YEAR 2000

The Number One Health Problems

The most important health problem in the West will be health problems stemming from an aging population, according to the scientists surveyed. Cardiovascular diseases, cancer and other conditions which tend to increase with age are expected to be the leading health problems in the developed world in the year 2000 (Table I-1). Selected excerpts from responses to this open-ended questions are presented in Verbatims I-1.

In the Third World, infectious diseases and malnutrition are expected to be the major health problems (Table I-2). Selected excerpts from the scientists' responses are presented in Verbatims I-2.

The Nation's Priority for Medical Research

They identify a wide variety of different priorities for biomedical research. At the top of the list, cited by 29%, is basic fundamental research with heavy emphasis on cell biology and cancer (Table I-3; Verbatims I-3).

Diseases Which Might Be Eliminated

Diseases which are most likely to be eliminated by the year 2000 are AIDS and measles according to 19% and 17% of the scientists, respectively (Table I-4; Verbatims I-4).

Expected Incidence of AIDS in the United States

Scientists working in three of the specialty areas -- cancer, biotechnology and infectious diseases -- predict there will be more than one million cases of AIDS in the United States by the year 2000 (Table I-10). This represents a median forecast, with estimates ranging widely. As many as 50% of those interviewed were unwilling to make an estimate.

An AIDS Vaccine

A majority (61%) think we will have a safe and effective vaccine against AIDS by 2010. Forty-six percent believe it will be available within the next 10 years (Table I-11).

An AIDS Cure

A majority (52%) also see a cure for AIDS by the year 2010 (Table I-12).

A Longer Life Span for Americans

Life expectancy for men will rise from 71 to 75 and for women, from 78 to 82, by the year 2,000 (median projections) (Table I-7).

The Biggest Frustration Scientists Will Face Over the Next 14 Years

The lack of adequate funds and financial support for research is felt to be the biggest frustration by 40% of the scientists (Table I-6; Verbatims I-6). Second on the list is government regulation and interference (9%).

2. CANCER

Leading researchers foresee an improved cure rate for cancer -- with doctors curing two out of every three patients by the year 2000. The cancer scientists forecast a steady improvement in the cancer cure rate from 50% today to 67% by the year 2000 (mean projection) (Table II-8). Almost all predict a cure rate of over 60% and almost one-third (31%) predict cure rates of 75% or higher.

According to a majority of the cancer researchers, the most basic, fundamental question that needs to be answered in order to achieve a major breakthrough in the treatment of cancer is understanding the mechanism of cell growth and differentiation or what transforms a normal cell into a cancer cell. Selected excerpts from responses to this open-ended question are presented in Verbatims II-2.]

A majority of the cancer researchers also take the position that significant progress against cancer will be made slowly, in a piecemeal fashion on a disease-by-disease basis rather than as the result of one central insight that helps control a number of different cancers (Verbatims II-3).

Ninety-three percent of all cancer researchers interviewed see elimination of smoking playing a wider role in the prevention of cancer by the year 2000 (Table II-5).

A big majority of the researchers also believe that three relatively new diagnostic techniques -- imaging techniques like PET (Positron Emission Tomography) and MRI (Magnetic Resonance Imaging), genetic markers for susceptibility to cancer and tests based on monoclonal antibodies -- will be in much wider use by the year 2000 (Table II-5).

Cancer researchers expect the highest degree of improvement in the prevention of lung cancer and markedly little improvement in the prevention of other cancers, such as brain cancer, pancreatic cancer, cancer of the ovaries, and leukemia (Table II-4).

Almost unanimously, they see a "smokeless society" as the most effective strategy in the prevention or treatment of lung cancer in the year 2000 (Verbatims II-4).

Cancer researchers expect the greatest amount of improvement in the treatment of leukemia, followed very closely by non-Hodgkin's lymphoma. the least amount of change will be in the treatment of liver, brain and pancreatic cancer (Table II-7).

Eighty percent foresee an increase in the use of monoclonal and polyclonal antibodies for the treatment of cancer (Table II-9).

They also see increased use of other novel therapies including bone marrow transplants, novel lymphonkines and cytokines, and interleukens. Conversely, about one-quarter of the researchers predict a decrease in the use of two of the more conventional cancer therapies: traditional radiation and surgery (Table II-9).

A majority, 60%, believe it will be possible to vaccinate people against certain types of cancer by the year 2000 (Table II-6).

3. CARDIOVASCULAR DISEASE

Researchers foresee elimination of most of the 70,000 coronary bypass operations which Americans undergo each year -- replaced by less invasive catheter-based procedures or clot dissolving drugs requiring no surgery at all (Tables III-8 and III-11).

The most promising areas of cardiovascular research are seen to be clot dissolving drugs and less-invasive diagnostic therapeutic techniques such as balloon angioplasty and other catheter-based techniques (Table III-1). Most scientists (90%) predict that heart transplants will be the preferred therapy over artificial hearts (Table III-9).

The fundamental question in cardiovascular research is understanding early stages and causes of atherosclerosis -- a degenerative disease of the arteries that is characterized by the deposit of fatty substances resulting in the narrowing of the passages of the blood vessels and ultimately resulting in hardening of the arteries and loss of elasticity (Verbatims III-1).

Fully 90% of the researchers predict that better prevention will do more than either treatment or diagnosis to combat cardiovascular disease (Table III-2).

They expect lifestyle modifications, such as exercise, smoking and nutrition, to be more widely adopted in the year 2000 (Table III-6; Verbatims III-4 and III-5). They also predict wider use of techniques such as clot-preventing drugs, genetic markers to screen for susceptibility to cardiovascular disease, heart imaging techniques, and plaque-preventing drugs.

Dietary changes, such as reduced intake of fat, sodium, cholesterol, and calories in general; reduced smoking; and increased exercise or physical activity are seen as the lifestyle changes which will do most to reduce the incidence and severity of cardiovascular diseases (Verbatims III-4).

Researchers see the greatest improvement in the treatment of hypertension (Table III-7). Improvement is also seen in the treatment of thromboembolisms, cardiac arrhythmias, myocardial infarctions, atherosclerosis, and congestive heart failure. Over 50% of the researchers expect at least a moderate degree of improvement in the treatment of these conditions by the year 2000.

Eighty-one percent see significant progress in predicting heart attacks (Table III-4); 62% in predicting strokes (Table III-5).

The majority of researchers expect drug therapies to be more widely used by the year 2000. Ninety-six percent say clot-dissolving drugs will be used more often, 86% expect greater use of anti-arrhythmia drugs, 76% see more use of plaque-dissolving drugs and 86% say there will be greater use of drugs to minimize damage to the heart muscle after a heart attack (Table III-8).

4. THE CENTRAL NERVOUS SYSTEM

The most promising area of central nervous system research is thought to be understanding the molecular biology of the brain, with an emphasis on understanding how receptors function in nerve cells, identifying new neurotransmitters, and the biological basis of psychiatric disorders (Table IV-1).

Greatest advances are seen for the treatment of depression, with almost two-thirds of CNS researchers projecting moderate to high levels of improvements (Table IV-5). At least one-half also predict moderate improvement in the treatment of Parkinsonism, epilepsy and of tardive dyskinesia -- a serious side effect of some anti-psychotic drugs resulting in involuntary repetitious movements of face, limb and trunk muscles.

Researchers predict a shift in favor of drugs in the balance between drug therapy and psychotherapy (Table IV-8).

They are almost unanimous (96%) in their opinion that traditional psychoanalysis will either be less used or scarcely used at all by the year 2000 (Table IV-6). About three-quarters of the CNS researchers forecast a decreased use of psychotherapy generally and psychosurgery, as well. Fifty percent of the central nervous system researchers feel that traditional psychoanalytic therapy will be "somewhat unimportant" in the year 2000. Thirty-six percent believe that it will be "not important at all" (Table IV-9).

In interpreting these findings it should be noted that the sample was weighted towards central nervous system scientists engaged in biomedical research. This emphasis on drug therapy may be a function of their biomedical, rather than clinical psychotherapeutic orientation.

The development of better drugs without side effects will provide the biggest advances in the prevention or treatment of schizophrenia and epilepsy (Verbatims IV-3 and IV-4).

Unanimously central nervous system scientists predict that molecular or immunological probes will be more widely used to detect diseases like Alzheimer's at their earliest stages (Table IV-4).

Treatments to delay or prevent neuronal loss in degenerative conditions such as Alzheimer's and Parkinsonism will play an important role in the year 2000, according to 87% of the researchers (Table IV-6). Other new therapeutic approaches, such as genetic engineering (87%), nerve growth and regeneration (86%) and brain tissue transplants (76%) will also be used more widely.

A majority of the researchers believe that the use of fetal brain tissue for human brain transplants both will (79%) and should (90%) be acceptable by the year 2000 (Tables IV-11 and IV-12).

5. INFECTIOUS DISEASES

Fifty-six percent of the scientists believe that better prevention, rather than better treatment, will do the most to combat infectious diseases in the year 2000 (Table V-2).

The greatest improvement in the prevention of infectious diseases is seen for hepatitis (66%), haemophilus (51%), and typhoid fever (49%). By contrast, 59% see no progress for preventing colds (Table V-3). They also are somewhat less optimistic in assessing improved prevention of sexually transmitted diseases such as herpes, AIDS and chlamydia (Table V-3), despite the forecast that there will be a successful vaccine for AIDS by the year 2010 (Table I-11).

A majority of the scientists forecast that genetically engineered vaccines (93%) and diagnostic tests based on monoclonal antibodies (88%) will be used much more widely in the year 2000 (Table V-4).

Research on genetically engineered vaccines is regarded as the most promising area. A large number of the scientists believe research on such vaccines (51%) and on diagnostic tests based on monoclonal antibodies (46%) to be most promising (Table V-1).

In Third World countries, malaria is seen as meriting top priority for research on infectious diseases (Verbatims V-3). The highest priority for research in developed countries should be given to AIDS, many scientists believe (Verbatims V-4).

The most frequently predicted important advance in the prevention or treatment of malaria and diarrhea is the development of a new and effective vaccine (Verbatims V-5 and V-6). They also see improved sanitation and better food and water conditions as important advances.

For the common cold, the emphasis shifts from prevention to treatment. A majority of response cited the development of better therapeutic anti-viral drugs as the biggest advance against the common cold. This was followed by better immunization (Verbatims V-7).

Ninety-five percent of the researchers expect that anti-viral drugs will be in wider use in the year 2000 (Table V-6).

6. NUTRITION

The fundamental question in nutritional research will be metabolism and metabolic regulation -- finding out how nutrients are dealt with at the cellular level (Table VI-1).

At the applied research level, nutritional scientists see the most promise in the field of maternal and child nutrition as well as the creation of food products that are higher in nutrients or resistant to drought, micro-organism and insects (Table VI-1).

They see nutritional research making its biggest gains in reducing infant mortality and morbidity -- most specifically in the support of pre-term and very low birth weight infants (Table IV-2).

Scientists see nutrition as playing an important role in the prevention of cancer and heart disease in the next century:

- 53% say doctors will advise patients to eat fiber-containing foods to help prevent cancer (Table VI-3).

- 63% say doctors will advise patients to limit consumption of cholesterol in the interest of preventing heart disease (Table VI-4).

Finally, a majority (65%) do not believe vitamin supplements will play a role in preventing cancer (Table VI-6).

7. BIOTECHNOLOGY

In applied use, the development of genetically engineered vaccines is seen as the most promising area of research (Table VII-1 and VII-2).

Genetically engineered vaccines also will have the highest impact on medical treatment according to 85% of the scientists (Table VII-3).

Biotechnology researchers (72%) see much or some improvements in the prevention or treatment of AIDS through products of biotechnology by the year 2000. The greatest improvement, however, is seen in the prevention or treatment of hepatitis (81%) and malaria (77%) (Table VII-4).

To a lesser extent, 58% also see some improvement resulting from products of biotechnology in the treatment or prevention of cancer and leukemia (Table VII-4).

[However, when all 227 scientists were asked to select the disease on which genetic engineering will have the greatest impact, more of them (26%) singled out cancer than any other disease (Table I-5).]

For the most part, biotechnology scientists are satisfied with government regulations assessing the risks and benefits of genetic engineering (Table VII-6). Eighty-six percent of them feel that the risks of genetic engineering have been greatly exaggerated and they see no need for stricter regulations (Table VII-7). Sixty-two percent also believe it is important to preserve natural genetic diversity through plant and animal gene banks (Table VII-8).

8. MEDICAL IMPLANTS

The year 2000 will see the common use of a wide range of artificial devices -- including implantable drug infusion systems in the body, implantable hearing aids, artificial blood and bones from bone banks, according to scientists interviewed in the survey (Table VIII-3).

The most important and most promising area of research for medical implants lies in the development of non-immunogenic materials -- that is, materials which are not rejected by the body's immune system (Table VIII-1).

Scientists see important advances in medical implant research in the development of drug delivery systems such as implantable drug infusion systems and implantable pumps to deliver drugs (Table VIII-2 and VIII-3).

They are particularly optimistic about implants for the treatment of arthritis (91%), diabetes (87%), deafness (83%), hormonal defects (87%), and cardiovascular disease (82%) (Table VIII-2).

Artificial knees, hips, skin and blood are also seen as being much more widely used by the next century. Penile implants and bone banks will also be more widely used, they believe (Table VIII-3).

CHAPTER I: THE WORLD IN THE YEAR 2000

The Number One Health Problem in the Developed World in the Year 2000

The most important health problem in the West will be health problems stemming from an aging population, according to the scientists surveyed. Cardiovascular diseases, cancer and other conditions which tend to increase with age are expected to be the leading health problems in the developed world in the year 2000 (Table I-1). Selected excerpts from responses to this open-ended question are presented in Verbatims I-1.

The Number One Health Problem in the Developing Countries in the Year 2000

In the Third World, infectious diseases and malnutrition are expected to be the major health problems (Table I-2). Selected excerpts from their responses are presented in Verbatims I-2.

The Nation's Priority for Medical Research Over the Next 14 Years

The scientists identify a wide variety of different priorities for biomedical research between now and the end of the century. At the top of the list, cited by 29%, is basic fundamental research with heavy emphasis on cell biology and cancer (Table I-3; Verbatims I-3).

The frequent references to diseases related to aging, as well as cancer and cardiovascular disease, closely parallel their perceptions of the major health problems facing the Western World (Tables I-1 and I-3).

Diseases or Conditions Which Might Be Eliminated by the Year 2000

Diseases which are most likely to be eliminated by the year 2000 are AIDS and measles according to 19% and 17% of the scientists, respectively (Table I-4; Verbatims I-4).

Genetic Engineering: Its Greatest Medical Impact by the Year 2000

Genetic engineering is expected to have its greatest impact on a wide variety of conditions. Heading the list is cancer, cited by 26% of the scientists, followed by diabetes (15%) and hemoglobin diseases (15%) (Table I-5; Verbatims I-5).

The Biggest Frustration Scientists Will Face Over the Next 14 Years

The lack of adequate funds and financial support for research is felt to be the biggest frustration by 40% of the scientists (Table I-6; Verbatims I-6). Second on the list is government regulations and interference (9%).

Limits to the Human Life Span and Life Expectancy in the Year 2000

Life expectancy for men will rise from 71 to 75 and for women, from 78 to 82, by the year 2000 (median projections) (Table I-7).

Ninety-three percent believe there is a limit to how much we can increase the human life span (Table I-8).

But, almost one-third foresee human life spans of over 100 for both men and women (Table I-9).

The Status of AIDS in the Year 2000

Expected Incidence of AIDS in the United States in the Year 2000: Scientists working in three of the specialty areas -- cancer, biotechnology and infectious diseases -- predict there will be more than one million cases of AIDS in the United States by the year 2000 (Table I-10). This represents a median forecast, with estimates ranging widely. As many as 50% of those interviewed were unwilling to make an estimate.

When a Safe and Effective Vaccine Against AIDS Will Be Generally Available: A majority (61%) think we will have a safe and effective vaccine against AIDS by 2010. Forty-six percent believe it will be available within the next 10 years (Table I-11).

When an Effective Cure for AIDS Will Be Generally Available: A majority (52%) also see a cure for AIDS by the year 2010 (Table I-12).

Table I-1

THE NO. 1 HEALTH PROBLEM IN THE DEVELOPED WORLD IN THE YEAR 2000

Base: All scientists

Q.: In the year 2000, what do you think will be the number one health problem in the United States and other western industrial countries?

	Total
Base	227
Cardiovascular Disease	78 34%
Cardiovascular disease	69 30%
Atherosclerosis	9 4%
Myocardial infarction	5 2%
Strokes	3 1%
Age-related health problems	61 27%
Cancer	60 27%
AIDS	17 7%
Life style related health problems	16 7%
Alzheimer's/Dementia	7 3%
Mental Disease	7 3%
Mental disease	4 2%
Depression	3 1%
Schizophrenia	1 *

(Continued)

Table I-1 (Continued)

THE NO. 1 HEALTH PROBLEM IN THE DEVELOPED WORLD IN THE YEAR 2000

Base: All scientists

	Total
Base	227
Infectious Disease	6 3%
Viral infections	5 2%
Infectious disease	2 1%
Nuclear catastrophy	4 2%
Auto-immune disease	3 1%
Overpopulation	2 1%
Malnutrition	2 1%
Accidents/injuries	2 1%
Air pollution	1 1%
Access of care to the population	1 1%
Low back pain	1 1%
Chronic pain	1 *
Cost to keep people alive forever	1 *
Cost of medical care	1 *

(Continued)

Table I-1 (Continued)

THE NO. 1 HEALTH PROBLEM IN THE DEVELOPED WORLD IN THE YEAR 2000

Base: All scientists

	Total
Base	227
Degenerative disease	1 *
Food preparation - carcinogens in food prep	1 *
Low birth weight infants	1 *
Don't know/no answer	5 2%

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*Less than 0.5%.

Verbatims I-1

THE NUMBER ONE HEALTH PROBLEM IN THE DEVELOPED WORLD IN THE YEAR 2000

Some Representative Quotes

Q.: In the year 2000, what do you think will be the number one health problem in the United States and other western countries?

"It will still be atherosclerosis. Vascular disease probably accounts for the most death and disability in the U.S. and Western countries. This has its effects in different ways: heart attacks, strokes, insufficiency of the vessels in the lower extremities. This will escalate in the aging population."

"The health problems will still be cancer and heart disease and life style created problems -- automobile and motorcycle injuries to young people. Add to that problems due to toxic waste build-up. My guess is that AIDS ought to be under control -- all the money and research is focused there. Mental problems associated with aging: more people live to be old, and these diseases will reveal themselves in a higher proportion of the population. These are so costly -- Alzheimer's, strokes, and Huntington's -- in terms of human life, and they have nothing to do with life style. Right now we're in the very early stages of looking for prevention and treatment."

"Geriatric disorders. Our population is aging, so people live longer but also acquire more difficulties and diseases like arthritis, musculo-skeletal diseases, senility, depression, loneliness -- in short, social diseases."

"Problems of aging, senile dementia and Alzheimer's disease will start to become much more of a problem requiring more research in neurochemistry. AIDS and other immunological diseases will pose threats also. The diseases of the Western World are those of aging. The cancers of affluence -- breast, colon, prostate and endometrial cancer -- will be important."

"As always, it is difficult to predict, but I will say that cancer and malignant disease will be the major problem. The reason for that is that cardiovascular disease is coming under control and cancer will become a major cause of death. In addition, degenerative diseases, such as cardiopulmonary and cerebral function will also emerge as significant degenerative diseases of the aging. I believe that the cancer problem will be the major problem."

"Cancer. The number one health problem will be geriatrics, and the treatment or problems related to it, specifically cancer. The population is shifting, it is growing older, and there is no way to get around it."

"I think cancer is still the most important disease. Then brain disease. It is an old disease, but a new problem. In general the trend is an increasing number of old people and therefore certain diseases -- such as cancer and brain disease -- will become more prevalent."

(Continued)

Verbatims I-1 (Continued)

THE NUMBER ONE HEALTH PROBLEM IN THE DEVELOPED WORLD IN THE YEAR 2000

Some Representative Quotes

"Diseases due to the mode of life. Cancer, heart disease and disease due to life style, overeating, drinking and too much drugs. All diseases due to life style."

"There will still be social diseases or, more accurately, self-inflicted diseases including obesity, alcoholism, drug abuse and all the infectious diseases that are transmitted by drug abuse. Diseases related to diet such as atherosclerosis. Environmentally-induced diseases including risks of accidental radiation effects."

"I think mental illness including drug addiction. The problem of mental illness is increasing as the average age of the population increases. It's also a social problem in terms of homeless people. It's coming into everybody's consciousness -- diseases like Alzheimer's and schizophrenia -- and there will be much more concentration on research in these areas."

"Something I find of great concern are diseases that don't affect mostly old people -- as cardiovascular and cancer -- but that affect people in their productive ages. And those health problems are trauma and injuries. Death due to injury in the productive years of life."

Table I-2

THE NO. 1 HEALTH PROBLEM IN THE DEVELOPING COUNTRIES IN THE YEAR 2000

Base: All scientists

Q.: What do you think will be the number one health problem in the developing countries in the year 2000?

	Total
Base	226
Infectious Diseases	126 56%
Infectious Diseases	103 45%
Infectious diseases	95 42%
Diarrhea	6 3%
Hepatitis	3 1%
Viral diseases	1 *
Pneumonia	1 *
Parasitic Disease	50 22%
Parasitic disease	39 17%
Malaria	14 6%
Malnutrition	104 46%
Population growth/control	22 10%

(Continued)

Table I-2 (Continued)

THE NO. 1 HEALTH PROBLEM IN THE DEVELOPING COUNTRIES IN THE YEAR 2000

Base: All scientists

	Total
Base	226
Cardiovascular	12 5%
AIDS	10 4%
Cancer	9 4%
Sanitation problems	6 3%
Health care delivery	6 3%
Aging/age-related problems	5 2%
Mental illness	3 2%
Infant mortality	2 1%
Alcoholism	2 1%
Hard drugs	1 *
Iodine deficiency	1 *
Diabetes	1 *
Iron deficiency	1 *
Don't know	4 2%

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*Less than 0.5%.

Verbatims I-2

THE NUMBER ONE HEALTH PROBLEM IN THE DEVELOPING COUNTRIES IN THE YEAR 2000

Some Representative Quotes

Q.: What do you think will be the number one health problem in the developing countries in the year 2000?

"In places that don't have a good purchase on population and malnutrition, I think it's likely to be what it is now: infectious diseases and malnutrition. Each area has its own indigenous scourges. Measles, for example, in Africa is a devastation even though a vaccine exists. I don't think you can single out a single disease; it's the gamut of infectious diseases that I'm speaking of."

"In the developing countries it will be malnutrition and maldistribution of resources."

"Food, that is nutrition, parasitic diseases, and public health problems such as waste disposal."

"Infectious diseases. And these will be old diseases -- diseases that are known. Also parasitic diseases. These will be increasing in prevalence because of the urbanization process."

"It will still be in large part control of infectious diseases. All the same as now, parasitic and bacterial diseases. Malaria would be one. The major problem will be inadequacy of delivery of high class drugs to the developing countries."

"As it is now and I think will still be, control of infection; and a correlated problem is nutrition. In infection, simple public health measures for control of infection are not in place. Some progress has been made, but not enough. Nutrition is a problem and goes together with infection because people who are undernourished are more susceptible to infection."

"Malaria and/or viral diseases such as HTLV/LAV or related viruses -- or new unrecognized viruses. Remember -- AIDS was only recognized five years ago -- we still have fourteen years to go!!"

"Diseases related to malnutrition. That is a broad spectrum, but would deal with decreased immunity, liver diseases, leading to increased mortality. Even cancers, such as hepotomas, with possible viral etiologies, even new viral and bacterial sources, all of these are related to decreased resistance to many diseases."

"Infection including parasitic ones in general. Lots of new initiatives, but incidence of disease will be far greater. Malaria and tuberculosis as examples. Infectious diseases in general. Cardiovascular disease and cancer will increase, but not as much."

(Continued)

Verbatims I-2 (Continued)

THE NUMBER ONE HEALTH PROBLEM IN THE DEVELOPING COUNTRIES IN THE YEAR 2000

Some Representative Quotes

"Likely to be disorders related to malnutrition. There are many factors involved. By 2000, there may be significant improvements in delivery of health care and elements which improve quality of life. But population growth and the rate of growth is very large in developing countries. This will continue for at least another decade. The supply of food and possibly water will be a serious problem in these countries."

"Infant mortality. I think it is at the present time one of the most serious health problems there, and there is little progress being made. I don't foresee any change in fourteen years."

"Malignancy and aging disorders, as the standard of life improves. Life expectancy is still very low so they don't have geriatric problems. We would expect they would have a higher life expectancy by then."

"Overpopulation. Unless more effective birth control methods are used, the population of a few countries will exceed those of the developed countries. We will have more people than resources."

"Overpopulation is likely to be the major health problem in developing countries, and in terms of diseases, I think malaria and other tropical diseases. That is the trend. Population is increasing, and while we are controlling many infectious processes, malaria, schistosomiasis, and other parasitic and protozoal diseases are much harder to contain."

Table I-3

THE NATION'S NO. 1 PRIORITY FOR MEDICAL RESEARCH OVER THE NEXT 14 YEARS

Base: All scientists

Q.: What do you think should be the nation's number one priority for medical research between now and the end of the century?

	Total
Base	227
Basic/Fundamental Research	65 29%
Basic/fundamental research	36 16%
Molecular/cellular biology	33 15%
Biomedical research	2 1%
Cancer	49 22%
Cancer	28 12%
Cancer treatment	11 5%
Cancer causes	8 4%
Cancer prevention	5 2%
Cardiovascular	32 14%
Cardiovascular prevention	11 5%
Cardiovascular	9 4%
Cardiovascular causes	8 4%

(Continued)

Table I-3 (Continued)

THE NATION'S NO. 1 PRIORITY FOR MEDICAL RESEARCH OVER THE NEXT 14 YEARS

	Total
Base	227
Atherosclerosis	4 2%
Cardiovascular treatment	4 2%
Preventive medicine	20 9%
All areas of research are important/ none have priority over the other	14 6%
Immunology	13 6%
AIDS	13 6%
Aging/age related problems	13 6%
Neuroscience	9 4%
Mental illness	8 4%
Etiology of disease	7 3%
Life style related problems, obesity/ smoking/alcohol	6 3%
Infectious Diseases	6 3%
Viral diseases	4 2%
Infectious diseases	2 1%
Anti-viral agents	1 *

(Continued)

Table I-3 (Continued)

THE NATION'S NO. 1 PRIORITY FOR MEDICAL RESEARCH OVER THE NEXT 14 YEARS

	Total
Base	227
Increased funding	6 2%
Vaccination/vaccine development	5 2%
Transfer of new knowledge into clinical practice/application of advances	4 2%
Researcher automony/freedom	4 2%
Brain disease	4 2%
Identifying population at risk	3 1%
Diet	3 1%
Inadequate number of research personnel	3 1%
Genetic diseases	3 1%
Emphasis on the productive - less on aging/terminally ill	2 1%
Endocrinology	2 1%
Epidemiology	2 1%
Population control	1 1%
Prevention of disc degeneration	1 1%
Research emphasis on human societal needs	1 1%

(Continued)

Table I-3 (Continued)

THE NATION'S NO. 1 PRIORITY FOR MEDICAL RESEARCH OVER THE NEXT 14 YEARS

	Total
Base	227
Degenerative diseases	1 1%
Pain research	1 *
Availability of health care	1 *
Artificial contraception/abortion	1 *
Identifying ineffective treatment	1 *
Don't know/no answer	2 1%

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*Less than 0.5%.

Verbatims I-3

THE NATION'S PRIORITY FOR MEDICAL RESEARCH OVER THE NEXT 14 YEARS

Some Representative Quotes

Q.: What do you think should be the nation's number one priority for medical research between now and the end of the century?

"In terms of federal funding of research, the majority of research, about 90%, is funded by the government. The federal government should give resources to basic biological sciences and not earmark the resources for specific targets or diseases. NOT set aside 50% of the budget for cancer research or viral diseases or stroke, etc., but provide funds to do fundamental research in the biological sciences. Researchers will select areas which are important. Applications are too difficult to predict. A cure for cancer might come from an investigator doing research related to smooth muscle cell proliferation as related to atheriosclerosis. Or alternatively, a person working in cancer examining processes by which cells replicate may find something more applicable to a cure for atheriosclerosis. In the past, our experiences trying to do this have not been good. Our attempts to cure broad diseases in a broad manner haven't worked."

"The number one priority should be the basic biological sciences. Full understanding of the biological research behind the biomedical research. As opposed to intervention programs, we need to concentrate on the biology of disease and life processes."

"I think the number one priority ought to be basic research on the mechanisms of disease. I mean by that lab or bench research. I think they are similar. Under the category of basic research I think that molecular biology and genetics should be among the highest priority, i.e., cell control mechanisms."

"I think it should revolve around the basic mechanisms of homeostasis at the molecular and cellular level. If we understand homeostasis and disease then we will be able to manipulate the body's response to disease better."

"I think that what is important to our national health research effort is that it extends all the way from creative ideas to clinical diagnosis and treatment. That chain is only as strong as its weakest link. I think that we need to make a continuing investment as a nation in the fundamental sciences, for example, molecular biology, genetics. We need to make significant investment and we need to balance that with the study of human diseases and treatment, so that the chain or the spectrum remains strong, remains well-integrated. We should not emphasize one thing at the expense of the rest. We should keep the entire chain well-integrated, well-balanced."

(Continued)

Verbatims I-3 (Continued)

THE NATION'S PRIORITY FOR MEDICAL RESEARCH OVER THE NEXT 14 YEARS

Some Representative Quotes

"I think prevention should be a leading priority for cancer research. Stopping smoking, for example, would reduce the commonest cancer in both men and women by 95%. But I think the number one priority should be research into how gene function is regulated and how we can use biological response modifiers."

"Cancer research. Genetic factors come very much into the foreground; and of course many people believe that we have a predestination with our genes. You probably have heard of "cancer families." If you have breast cancer in your family, for example, you are at higher risk. So, to pre-determine which disease you might get, genetic susceptibility in cancer is very important to study."

"Immunological diseases because we don't know much about immune defects: Arthritis, Lupus, diabetes, rheumatic fever leading to heart diseases, myasthenia gravis. They are all caused in response to pathogenic agents. Vaccine design, now very preliminary, will be of great benefit."

"The nation's priorities for medical research should focus on coronary heart disease. It will also be necessary to focus substantial attention on cancer. These diseases affect so many people that considerable effort must be put towards understanding them."

"In my view, it should be prolonging the independent phase of living of the elderly. There are two concepts: (a) prolonging life and (b) prolonging the active life expectancy which is more important because it means independence of the individual."

"Speaking of this nation, the U.S.: Increased emphasis on research on MAN as distinct from the molecules of man; by that I mean the whole man, away from reductionism."

Table I-4

DISEASES OR CONDITIONS WHICH MIGHT BE ELIMINATED BY THE YEAR 2000

Base: All scientists

Q.: Smallpox has been eliminated. Are there any other diseases or conditions which you think there is a reasonable chance of our eliminating by the year 2000?

	Total
Base	226
AIDS	43 19%
Measles	38 17%
Poliomyelitis	34 15%
Malaria	28 12%
Hepatitis	23 10%
Hepatitis	14 6%
Hepatitis B	9 4%
Hepatitis A	1 1%
Cancer	16 7%
Leukemia	8 4%
Cancer	4 2%
Breast cancer	2 1%
Hepatocellular carcinoma	2 1%

(Continued)

Table I-4 (Continued)

DISEASES OR CONDITIONS WHICH MIGHT BE ELIMINATED BY THE YEAR 2000

Base: All scientists

	Total
Base	226
Lung cancer	1 1%
Hodgkins Lymphoma	1 *
Infectious disease	16 7%
Rubella	12 5%
Viral disease	10 4%
Whooping cough	9 4%
Diphtheria	8 4%
Schistosomiasis	7 3%
Tuberculosis	7 3%
Mumps	7 3%
Cardiovascular Disease	7 3%
Cardiovascular disease	5 2%
Atherosclerosis	1 1%
Chicken pox	6 3%

(Continued)

Table I-4 (Continued)

DISEASES OR CONDITIONS WHICH MIGHT BE ELIMINATED BY THE YEAR 2000

Base: All scientists

	Total
Base	226
Typhoid fever	5 2%
Huntington's chorea	5 2%
Diabetes	4 2%
Hereditary diseases	4 2%
Trypanosoma	3 1%
Multiple sclerosis	2 1%
Alzheimer's disease	2 1%
Cholera	2 1%
Pneumonia	2 1%
Leprosy	2 1%
Environmental health problems	2 1%
Cystic fibrosis	2 1%
Malnutrition	2 1%
Scarlet fever	2 1%

(Continued)

Table I-4 (Continued)

DISEASES OR CONDITIONS WHICH MIGHT BE ELIMINATED BY THE YEAR 2000

Base: All scientists

	Total
Base	226
Rabies	2 1%
Sickle Cell Anemia	2 1%
Thalassemia	2 1%
Hemophilia	2 1%
Kawasaki	2 1%
Cigarette smoking	1 1%
Osteoarthritis	1 1%
Arthritis	1 1%
Low back pain	1 1%
Gaucher	1 1%
Prematurity	1 1%
Prematurity	1 *
Hyaline membrane disease	1 *
Vitamin deficiency	1 1%

(Continued)

Table I-4 (Continued)

DISEASES OR CONDITIONS WHICH MIGHT BE ELIMINATED BY THE YEAR 2000

Base: All scientists

	Total
Base	226
Iatrogenic birth defects	1 *
Schizophrenia	1 *
Psychiatric diseases	1 *
Cystomyosis	1 *
Herpes	1 *
Yaws	1 *
Immune diseases	1 *
Rota	1 *
Dysentery	1 *
Influenza	1 *
Emphysema	1 *
Lead poisioning	1 *
Death from organ disease	1 *
Gallbladdar surgery	1 *

(Continued)

Table I-4 (Continued)

DISEASES OR CONDITIONS WHICH MIGHT BE ELIMINATED BY THE YEAR 2000

Base: All scientists

	Total
Base	226
Diarrhea	1 *
RH Erythroblastosis	1 *
Osteoporosis	1 *
Rickets	1 *
Goiter	1 *
Vitamin A deficiency	1 *
Don't know/no answer	14 6%
None	39 17%

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*Less than 0.5%.

Verbatims I-4

DISEASES OR CONDITIONS WHICH MIGHT BE ELIMINATED BY THE YEAR 2000

Some Representative Quotes

Q.: Smallpox has been eliminated. Are there any other diseases or conditions which you think there is a reasonable chance of our eliminating by the year 2000?

"I would say AIDS. The problem with AIDS is the same as with smallpox and polio because it requires a vaccine and a massive inoculation effort. Some other viral diseases, such as measles, for the same reasons."

"AIDS. I say that because it's the target of huge interest in the U.S. and if treatments are developed here they will be exported to other countries with a high incidence of the disease, like Haiti and Africa."

"Infectious diseases such as measles are possible if more money is put towards that end. AIDS, possibly.

"Many diseases could be eliminated but the government just will not allocate the resources. As a result, I still have to be pessimistic and say none will be eliminated. We should have the ability to control AIDS, measles, and genetic disorders, such as muscular dystrophy, cystic fibrosis, Huntington's disease. All these are within our power to control."

"Malaria. By wiping out mosquitos which transmit it. We have a good chance at eliminating infectious diseases if we have organized programs which are adequately funded."

"Infectious diseases such as rubella, whooping cough,, diphtheria, malaria, schistomiasis. Malnutrition, cardiovascular disease through improved diet and reduction or elimination of cigarette smoking."

"Cardiovascular diseases. We've learned a lot about prevention, drug therapy, and style of life. Depression. These won't be eliminated, but may be better treatable."

"I think there are several, if we get good immunization and vaccination programs going: measles, whooping cough, polio, if we were to put the same effort into it as was put into eliminating smallpox."

"I think there is certainly a chance to eliminate inherited metabolic disorders. I could foresee the possibility to cure diabetes through either transplantation of islet cells or restore the proper molecular machinery of the cells to produce insulin via genetic engineering. Enzyme deficiency disorders such as Gaucher, Niemann-Pick, or Tay-Sachs."

(Continued)

Verbatims I-4 (Continued)

DISEASES OR CONDITIONS WHICH MIGHT BE ELIMINATED BY THE YEAR 2000

Some Representative Quotes

"Certain cancers are possible: leukemia, lymphomas, some other specific cancers via early detection, such as breast cancer. Cervical cancer has been tremendously diminished with routine use of PAP smears."

"I would have to say no. I'm really rather pessimistic about eliminating any other diseases in fourteen years.

"Depends on if we want to. We eliminated smallpox because the effects were so dire. We could eliminate all common viral diseases, chickenpox, measles, those types, if we wanted to. But we won't. Parasitic diseases of all kinds are very serious. We should concentrate on those."

"Smallpox was unique. An obliging parasite, and other factors led to its elimination. Measles and polio are good candidates but have intrinsic problems, which will make them difficult to completely eliminate, much less by 2000.

Table I-5

THE GREATEST MEDICAL IMPACT OF GENETIC ENGINEERING BY THE YEAR 2000

Base: All scientists

Q.: Obviously, genetic engineering has the potential to affect many different areas of medicine. If you had to pick a single disease or condition on which genetic engineering will have the greatest impact by the year 2000, what would it be?

	Total
Base	227
Cancer	58 26%
Cancer	51 23%
Leukemia	4 2%
Hematologic cancers	2 1%
Cancer chemotherapy	1 1%
Breast cancer	1 *
Diabetes	35 15%
Hemoglobin Diseases	33 15%
Sickle Cell Anemia	21 9%
Thalassemia	13 6%
Hemoglobin diseases	5 2%
Cystic Fibrosis	13 6%
AIDS	12 5%

(Continued)

Table I-5 (Continued)

THE GREATEST MEDICAL IMPACT OF GENETIC ENGINEERING BY THE YEAR 2000

Base: All scientists

	Total
Base	227
Growth hormone deficiencies	12 5%
Cardiovascular Disease	12 5%
Cardiovascular disease	6 3%
Hypertension	4 2%
Myocardial infarction	2 1%
Genetic disease	10 4%
Metabolic Diseases	10 4%
Huntington's chorea	9 4%
Infectious Diseases	9 4%
Viral diseases	3 1%
Vaccine development	3 1%
Infectious diseases	2 1%
Malaria	7 3%
Hemophilia	6 3%

(Continued)

Table I-5 (Continued)

THE GREATEST MEDICAL IMPACT OF GENETIC ENGINEERING BY THE YEAR 2000

Base: All scientists

	Total
Base	227
Alzheimer's	5 2%
Immune System Research/Diseases	4 2%
Immune system research/diseases	4 2%
Histocompatability research	1 *
Hepatitis	4 2%
Hepatitis B	3 1%
Hepatitis	1 *
Developing new foods: resistance to adverse conditions	3 2%
Genetically engineered interferon	3 1%
Mental Illness	3 1%
Mental illness	1 1%
Severe depression	1 *
Gaucher's disease	2 1%
Aid in diagnosis	2 1%

(Continued)

Table I-5 (Continued)

THE GREATEST MEDICAL IMPACT OF GENETIC ENGINEERING BY THE YEAR 2000

Base: All scientists

	Total
Base	227
Identifying sequences of protein	2 1%
Malnutrition	2 1%
Lesch-Nyhan syndrome	2 1%
DNA recombination studies	2 1%
Production of hormones	1 1%
Genetic screening	1 1%
Bone marrow transplantation	1 1%
Diseases of the endocrine system	1 1%
Stimulation of bone formation	1 1%
Arthritis	1 1%
Blood enzyme deficiency diseases	1 *
Tay-Sachs	1 *
Muscular Diseases	1 *
Brain Peptide Research	1 *

(Continued)

Table I-5 (Continued)

THE GREATEST MEDICAL IMPACT OF GENETIC ENGINEERING BY THE YEAR 2000

Base: All scientists

	Total
Base	227
Pheny/Kelonuria	1 *
Monogenic disorders	1 *
Kidney failure	1 *
Connecting pathology of blood forming diseases	1 *
Enzyme deficiency diseases	1 *
Alcoholism	1 *
Gene insertion	1 *
Production of antibiotics	1 *
Cellular differentiation control	1 *
Clot dissolution	1 *
Aging	1 *
Manipulation of the genome	1 *
Don't know/no answer	16 7%
None	4 2%

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*Less than 0.5%.

Verbatims I-5

THE GREATEST MEDICAL IMPACT OF GENETIC ENGINEERING BY THE YEAR 2000

Some Representative Quotes

Q.: Obviously, genetic engineering has the potential to affect many different areas of medicine. If you had to pick a single disease or condition on which genetic engineering will have the greatest impact by the year 2000, what would it be?

"It will be cancer. Generally, genetic engineering will determine effective treatment of all forms of cancer. Cancer is many diseases. Genetic engineering will sort this out and have a major impact in the next twelve to fifteen years."

"Cancer. I think that as a group cancer is more likely to be controlled. The sequencing of the human genome and knowing how to manipulate genes is of major importance. The importance of this is demonstrated by the fact that at NIH one half of the molecular biology is supported by the Cancer Institute and this is because we see that as having a major impact."

"In the coming year the greatest impact will actually be on cardiovascular diseases because they are right now developing a new geneticaly engineered drug that will come out next year. Overall, I think genetic engineering will have its biggest impact on cancer because it bears directly on the mechanics of cancer development, i.e., on changes at the genetic level. I guess the development of things such as monoclonal antibodies could have a big effect on certain cancers."

"The whole host of minor genetic diseases where the introduction of new genes could make a major impact, like thalassemia. I think that is where we are going to make a major impact with genetic engineering. There are other possibilities too, for example, in cancer research and therapy we may be able to introduce genes into tissues like bone marrow to make them resistant to the toxic effects of some of our anti-cancer agents."

"Diseases due to inborn errors of metabolism, e.g., lysosomal storage diseases, phenylketonuria. By enzyme replacement therapy, large amounts of enzymes can be made by genetic engineering. These enzymes can then be administered and will eliminate toxic metabolic byproducts. The problem today is that we cannot get enough of these enzymes."

"The hereditary disorders of the blood forming organs, such as adenine (ADA) deficiency. This will be accomplished by supplement therapy. We may actually be able to inject deficient chromosomes in certain disorders, thereby curing hemophilia and thalassemia."

"I would suspect that genetic engineering would have the greatest effect on diseases like diabetes, where only one gene product is involved. Diseases with more than one gene problem will be more difficult."

(Continued)

Verbatims I-5 (Continued)

THE GREATEST MEDICAL IMPACT OF GENETIC ENGINEERING BY THE YEAR 2000

Some Representative Quotes

"Blood diseases, because we can completely regenerate someone's blood-forming system, so we can wipe out what they have and give them all new cells. The greatest impact will be on sickle cell anemia."

"I would guess, in terms of the number of people affected, it would be diabetes. Now, you don't hear of many people dying of diabetes. In terms of saving lives, I guess it would be malignant diseases."

"I think it's going to be in the area of extraordinary disorders such as Huntington's Chorea and storage diseases, diseases where a single gene is involved and it could be replaced. The hope was that genetic engineering would cure cancer, but I don't see it happening by the year 2000. We stand a better chance when there is a known enzymatic deficiency, such as in cystic fibrosis."

Table I-6

THE BIGGEST FRUSTRATIONS FACED BY RESEARCH SCIENTISTS OVER THE NEXT 14 YEARS

Base: All scientists

Q.: What do you think will be the biggest frustration for scientists working in the field of .... over the next 14 years?

(NOTE: This question was asked of all scientists as it applied to their area of specialty.)

	Total
Base	226
Lack of Adequate Funds/Support	91 40%
Lack of adequate funds/support	85 38%
Lack of support for long term research	7 3%
Government/Bureaucratic Interference/Regulations	20 9%
Regulations regarding animal research/ interference with animal research	6 3%
Government/bureaucratic interference/ regulations	5 2%
Lack of freedom for scientists/ researchers	5 2%
Regulations regarding studies on humans	3 1%
Drug regulatory groups/getting drugs accepted	2 1%
Organized reporting to government in medical sciences	1 *
Prevention: Motivating public to change habits	14 6%
Lag between advances & application	10 5%

(Continued)

Table I-6 (Continued)

THE BIGGEST FRUSTRATIONS FACED BY RESEARCH SCIENTISTS OVER THE NEXT 14 YEARS

Base: All scientists

	Total
Base	226
Immunology rejection of immune response	9 4%
Understanding molecular/cell biology	6 3%
Need new antibiotics/drugs	6 3%
Don't know/no answer	6 2%
Difficulty getting collaboration from experts	5 2%
Complexity of central nervous system function	5 2%
Lack of recognition/interest in the field	5 2%
Complexity of the problem	5 2%
Understanding precise role of dietary factors in disease	4 2%
Slowness of progress	4 2%
Drug resistance	4 2%
Keeping up with knowledge/advances	4 2%
Lack of research personnel	4 2%
Response to implants	3 1%

(Continued)

Table I-6 (Continued)

THE BIGGEST FRUSTRATIONS FACED BY RESEARCH SCIENTISTS OVER THE NEXT 14 YEARS

Base: All scientists

	Total
Base	226
Improved fixation of implants	3 1%
Understanding how brain functions	3 1%
Differences between normal & cancer cell	2 1%
Increasing cure rate	2 1%
Population's access to technology/knowledge	2 1%
Results/drugs proven ineffective in human trials (when effective in animals/in-vitro)	2 1%
Etiologies of mental disorders	2 1%
Lack of complete knowledge of nutrient metabolism	2 1%
Lack of animals for research	2 1%
Appearance of new disease/virus	2 1%
Many questions as to how genes are regulated	2 1%
Therapeutic trials anticipated before understanding mechanism	2 1%
Understanding mechanics of acute coronary event	2 1%
Basic mechanism of atherosclerosis	2 1%

(Continued)

Table I-6 (Continued)

THE BIGGEST FRUSTRATIONS FACED BY RESEARCH SCIENTISTS OVER THE NEXT 14 YEARS

Base: All scientists

	Total
Base	226
Mechanism of control of lipoprotein synthesis	2 1%
Growing incidence of cardiomyopathy	2 1%
Side effects of drugs	2 1%
Age related problems	2 1%
Introducing DNA into organisms	2 1%
Population unresponsible to findings	1 1%
Understanding the control mechanism for bone homeostasis or remodeling	1 1%
Finding materials which mimic properties of substances they are intended to replace	1 1%
Understanding mechanics of tissue and interaction between mechanism of regeneration and remodeling	1 1%
Understanding basic mechanism/etiologies	1 1%
Quality of researchers	1 1%
Limitations of in-vitro studies	1 *
Difficulty getting access to brain autopsy material	1 *
Transition from simple links to high level organization of central nervous system	1 *

(Continued)

Table I-6 (Continued)

THE BIGGEST FRUSTRATIONS FACED BY RESEARCH SCIENTISTS OVER THE NEXT 14 YEARS

Base: All scientists

	Total
Base	226
Understanding memory problems	1 *
Developing methodologies to isolate neural systems	1 *
How animal systems fit into human brain	1 *
Inadequate access to appropriate patient populations for study	1 *
Close to solution, someone else resolves first	1 *
Multiplicity	1 *
Need to emphasize global issues	1 *
Understanding aspects of chemotherapy	1 *
New surgeries which increase susceptibility of patient to micro organisms	1 *
Societal resistance to use high technology	1 *
Coping with genetic variation	1 *
Anti-genetic viruses	1 *
Suppression of scientific dissent from scientists	1 *
Ability to think creatively	1 *

(Continued)

Table I-6 (Continued)

THE BIGGEST FRUSTRATIONS FACED BY RESEARCH SCIENTISTS OVER THE NEXT 14 YEARS

Base: All scientists

	Total
Base	226
Finding with every asset there is a liability	1 *
Cost of working with human subjects	1 *
Difficulty doing clinical studies: patients' cooperation	1 *
To determine relevant outcome measurements in infant nutrition	1 *
Variables of human biology & genetics	1 *

Verbatims I-6

THE BIGGEST FRUSTRATION SCIENTISTS WILL FACE OVER THE NEXT 14 YEARS

Some Representative Quotes

Q.: What do you think will be the biggest frustration for scientists working in the field of..... over the next 14 years?

(Note: this question was asked of all scientists as it applied to their area of specialty.)

"Same frustration that we have now if things don't change. The National Cancer Act of 1971 provided resources that allowed the cancer program to reach critical mass. It was perceived by some that we were at critical mass, rather. We were not. The term critical mass is used in physics -- if you put two pieces of uranium together which contain particles like neutrons there may be fusion or fission, and when the numbers and conditions are right, we'll get an explosion. Now, with a similar infusion of resources, we would go up to the top. If we don't get enough dollars, however we may be thrown back a decade. We could go over the top if we get enough resources. This means making cancer a fading disease."

"Limited funds and politics. One of the problems is when funds are limited, our decisions are made on practical, rather than long-term needs. Not addressing the fundamental questions. For example, one can provide funds for treating clots in atherosclerotic vessels, or funds for why does atherosclerosis develop. It would be as if you were told to drive on polio, and your money went for making a better respirator; when there are limited funds, those priorities have to be made."

"The government reimbursement system. There will be no advance in implant research with a government that wants the cheapest methods, cheapest devices, cheapest everything."

"Support, financial support. It determines if good people go into science."

"Financing. The public and government agencies do not understand how cheap research is and how broad the return is. It reaps rewards in unexpected areas and much more money needs to be allotted for broad-based research."

"I don't think it will be an intellectual frustration. Science is in such an exciting state of fermentation -- it is moving so quickly. I'm afraid the frustration will be erratic public policy and erratic guidance and finally erratic funding."

"Regulation -- actually, over-regulation! The time and repetitious nature of clinical and preclinical trials needed to get drugs accepted in various countries."

(Continued)

Verbatims I-6 (Continued)

THE BIGGEST FRUSTRATION SCIENTISTS WILL FACE OVER THE NEXT 14 YEARS

Some Representative Quotes

"Regulations on ability to conduct clinical research with new ideas. For example, people who can do much with genetic engineering are faced with great difficulties in getting approval for their experiments."

"The slowness of the progress which will result in disenchantment by those who control the money and which permits freedom of expression in research. The frustrations of intellectual accomplishment probably will be no bigger than what they are today, but the factors which make the work difficult, such as money, bureaucracy, administration, committees directing research direction, etc., will escalate."

"In prevention, the behavioral aspects of people. Impact of behavior is needed to prevent most disorders. We can't motivate people to do the things they must to prevent disease. This is the biggest stumbling block now."

"Finding ways of preventing heart disease with a non-compliant population and a non-cooperative government. For instance, recommended changes in diet and smoking are not only slow to be picked up by the general public but are fought against at the government level by industry-funded lobby groups."

"The biggest frustration will be a discrepancy between development and application. As we improve our ability, the biggest thing will be, to prevent or treat diseases faster than we will be able to apply what we have learned."

Table I-7

LIFE EXPECTANCY IN THE U.S. IN THE YEAR 2000

Base: All scientists

Q.: Finally a question on life expectancy. The life expectancy of men and women in the United States is about 71 and 78 respectively. What is your best guess for what the life expectancy of men and women in the U.S. will be in the year 2000?

Base: 226	Men	Women
71 - 74	81 36%	- -
75 - 77	80 35%	5 2%
78 - 80	38 17%	76 34%
81 - 84	15 7%	84 37%
85 - 86	5 2%	34 15%
87 - 90	- -	17 8%
91 - 100	4 2%	6 3%
Mean	76	82
Median	75	82
Don't know/no answer	3 1%	3 1%

Table I-8

IS THERE A LIMIT TO THE HUMAN LIFE SPAN?

Base: All scientists

Q.: Do you think there is any limit to how much we can increase the human life span, or do you think we can go on increasing it indefinitely?

	Total
Base	227
There is a limit	210 93%
Go on increasing it indefinitely	14 6%
Not sure	3 1%

Table I-9

WHAT LIMITS ARE THERE TO THE HUMAN LIFE SPAN?

Base: Those who think there is a limit to the human life span

Q.: What do you think that limit is for men? For women?

	Men	Women
Base	209	206
75 - 77	12 6%	- -
78 - 81	20 10%	11 5%
82 - 85	13 6%	22 11%
86 - 90	27 13%	26 13%
91 - 95	14 6%	17 8%
96 - 100	43 20%	45 22%
101 - 105	12 6%	11 5%
106 - 115	20 9%	26 13%
116 - 129	26 13%	25 12%
130 - 150	7 3%	8 4%
Mean	99	101
Median	100	100
Don't know/no answer	15 7%	15 7%

Table I-10

AIDS: EXPECTED INCIDENCE IN THE YEAR 2000

Base: Biotechnology, cancer, and infectious diseases scientists

Q.: The United States Public Health Service estimates that by 1991 there will be a cumulative total of more than 270,000 cases of AIDS in the United States alone. Assuming there were no dramatic advance in preventing or treating the disease, what do you think the figure is likely to be in the year 2000?

Base: 85	
100,000 - 999,999	15 18%
1,000,000 - 4,999,999	19 22%
5,000,000 - 19,999,999	5 6%
20,000,000 - 99,999,999	3 3%
100,000,000	1 1%
Not sure	42 50%
Median	1,080,000

Table I-11

AIDS: WHEN CAN WE EXPECT AN EFFECTIVE VACCINE?

Base: Biotechnology, cancer, and infectious diseases scientists

Q.: By what year do you think a safe and effective vaccine against AIDS will be generally available?

Base: 90	
1990 - 1999	41 46%
2000 - 2010	14 15%
2011 - 2030	3 3%
Never	7 8%
Not sure	25 28%
Median	1996

Table I-12

AIDS: WHEN CAN WE EXPECT AN EFFECTIVE CURE?

Base: Biotechnology, cancer, and infectious diseases scientists

Q.: By what year do you think an effective cure for AIDS will be generally available?

Base: 89	
1990 - 1999	25 28%
2000 - 2010	21 24%
2011 - 2030	5 6%
Never	13 15%
Not sure	25 28%
Median	2000

CHAPTER II: CANCER: LOOKING AHEAD TO THE YEAR 2000

RESEARCH ON CANCER

Most Promising Areas of Cancer Research

Molecular regulation of gene expression -- understanding what makes a healthy cell become a cancer cell -- will be the most promising area of cancer research by the year 2000 (Table II-1).

The Most Fundamental Question in Basic Cancer Research

According to a majority of the cancer researchers, the most basic, fundamental question that needs to be answered in order to achieve a major breakthrough in the treatment of cancer is understanding the mechanism of cell growth and differentiation or what transforms a normal cell into a cancer cell. Selected excerpts from responses to this open-ended question are presented in Verbatims II-2.

A majority of the cancer researchers also take the position that significant progress against cancer will be made slowly, in a piecemeal fashion on a disease-by-disease basis rather than as the result of one central insight that helps control a number of different cancers (Verbatims II-3)

THE PREVENTION, DIAGNOSIS AND TREATMENT OF CANCER

Will Better Prevention, Better Diagnosis, or Better Treatment Do Most to Combat Cancer in the Year 2000?

A majority, 63% of the cancer researchers, believe that better prevention will do more than treatment or diagnosis to combat cancer in the year 2000 (Table II-2).

Scientists' Views on the Cancer Prevention vs. Treatment Controversy

Table II-3 indicates that 63% of the cancer researchers disagree with Bailar and Smith's conclusion in the New England Journal of Medicine that cancer treatment is not getting a whole lot better. Fifty-four percent also disagree with Bailar and Smith's recommended shift in emphasis from treating cancer to preventing it.

THE PREVENTION AND DIAGNOSIS OF CANCER

Degree of Improvement Expected in the Prevention of Cancer by the Year 2000?

Cancer researchers expect the highest degree of improvement in the prevention of lung cancer and markedly little improvement in the prevention of other cancers, such as brain cancer, pancreatic cancer, cancer of the ovaries, and leukemia by the year 2000 (Table II-4).

Ways of Preventing and Diagnosing Cancer: How Widely They Will Be Used in the Year 2000

More than anything else, elimination of smoking will be most widely used in the prevention of cancer by the year 2000. Almost unanimously, 93% of all cancer researchers interviewed see elimination of smoking as playing a wider role in the prevention of cancer (Table II-5).

A big majority of the researchers also believe that three relatively new diagnostic techniques -- imaging techniques like PET (Positron Emission Tomography) and MRI (Magnetic Resonance Imaging), genetic markers for susceptibility to cancer and tests based on monoclonal antibodies -- will be in much wider use by the year 2000 (Table II-5).

Will We Have a Cancer Vaccine by the Year 2000?

A majority, 60% of the cancer researchers, believe that it will be possible to vaccinate people against certain types of cancer by the year 2000 (Table II-6).

THE TREATMENT OF CANCER

Degree of Improvement Expected in the Treatment of Cancer by the Year 2000

Cancer researchers expect the greatest amount of improvement in the treatment of leukemia, followed by non-Hodgkin's lymphoma. The least amount of change will be in the treatment of liver, brain, and pancreatic cancer (Table II-7).

Lung and Breast Cancer: Cancer researchers were asked to comment on what they thought the biggest advance in the prevention or treatment of lung and breast cancer would be in the year 2000.

Almost unanimously, they see a "smokeless society" as the most effective strategy (Verbatims II-4). When asked what one change in lifestyle would do most to reduce the incidence and severity of cancer generally (not just lung cancer), the majority unequivocally advocate eliminating smoking (Verbatims II-5).

For breast cancer, the most frequently-mentioned advance relates to early detection, to a much lesser degree, cancer scientists also believe that advances in nutrition and diet -- specifically, lessening the amount of fats in our diet -- will play an important role (Verbatims II-6).

The Cure Rate for Cancer by the Year 2000

The cancer scientists forecast a steady improvement in the cancer cure rate from 50% today to 67% by the year 2000 (mean projection) (Table II-8). A large majority (85%) predict a cure rate of 60% or over and almost one-third (31%) predict cure rates of 75% or higher.

Methods of Treating Cancer: How Widely They Will Be Used in the Year 2000

Eighty percent of the cancer researchers foresee an increase in the use of monoclonal and polyclonal antibodies, in general (Table II-9). In particular, they foresee increased use of drug-antibody conjugations which link drugs to monoclonal antibodies to deliver them to targeted cells.

They also see increased use of other novel therapies including bone marrow transplants, novel lymphokines and cytokines, and interleukens. Conversely, about one-quarter of the scientists predict a decrease in the use of two of the more conventional cancer therapies: traditional radiation and surgery.

Expected New Therapies for Cancer in the Year 2000

When asked to comment on what important, completely new types of therapy for cancer can be expected by the year 2000, the development of monoclonal antibodies and differentiation agents led the responses (Verbatims II-7).

Table II-1

CANCER: MOST PROMISING AREAS OF RESEARCH

Base: Cancer scientists

Q.: I will read you a short list of some of the major areas of cancer research. Please say for each one how promising you think it is on a scale of 0 to 10 where 0 is "not promising at all" and where 10 is "most promising one could imagine".

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 40	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Molecular regulation of gene expression	21 53%	9 23%	6 15%	1 3%	3 8%	9
Oncogenes	18 45%	12 30%	6 15%	3 8%	1 3%	8
Cell differentiation and its regulation	17 43%	17 43%	4 10%	1 3%	1 3%	8
Molecular mechanisms of initiation and promotion	17 43%	12 30%	10 25%	- -	1 3%	8
Tumor viruses	15 38%	9 23%	9 23%	6 15%	1 3%	8
Genetic markers for susceptibility to cancer	12 30%	15 38%	6 15%	6 15%	1 3%	8
New imaging techniques	10 25%	13 33%	9 23%	6 15%	2 5%	7
Monoclonal and polyclonal antibodies	8 20%	18 45%	11 28%	2 5%	1 3%	7
Identifying and reducing exposure to carcinogens	8 20%	14 35%	9 23%	9 23%	- -	7
Nutritional guidelines to prevent cancer	6 15%	9 23%	13 33%	12 30%	- -	6
Biological response modifiers	4 10%	14 35%	13 33%	7 18%	2 5%	6

(Continued)

Table II-1 (Continued)

CANCER: MOST PROMISING AREAS OF RESEARCH

Base: Cancer scientists

Base: 40	Expected Degree of Promise Rating Level on a Scale of 0 to 10 Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Relation between aging and cancer	3 8%	10 25%	18 45%	9 23%	- -	6
Mechanisms of tumor vascularization	2 5%	17 43%	9 23%	11 28%	1 3%	6
Retinoids and other redifferentiation agents	1 3%	9 23%	13 33%	13 33%	4 10%	5.5
Anti-metastasis	5 13%	9 23%	12 30%	12 30%	2 5%	5
Surgery	5 13%	5 13%	10 25%	19 48%	1 3%	5
Cytotoxic drugs	4 10%	8 20%	15 38%	13 33%	- -	5
Radiotherapy	3 8%	7 18%	15 38%	14 35%	1 3%	5
Tumor-specific antigens	2 5%	7 18%	14 35%	16 40%	1 3%	5
Free-radical scavengers	- -	5 13%	13 33%	18 45%	4 10%	4.5

Verbatims II-1

PROMISING AREAS OF CANCER RESEARCH

Some Representative Quotes

Q.: Is there any other major area of cancer research which is more promising than those I have mentioned? If so, what is it?

"Drug resistant genes. There is a family of genes used by normal cells to produce enzymes which are resistant to environmental toxins. Cells can also use these gene products to make them resistant to certain drugs. This family of genes is similar to the immunogobulin genes that produce antibodies. It appears that we can control those genes that make people resistant to drugs in order to allow them to use drugs to control the cancer."

"... The sequencing of the total human genome and the determination of what might be thought of as an optimally balanced genome ... We're all a little bit different so those of use who survive have a favorable balance of desirable and undesirable genes. Some of us develop cancer in response to environmental insults."

"Epidemiology in relation to environmental causes of cancer."

"Growth factors are very important. Also, drug resistance and particularly its circumvention is going to be very important. Also, the design of strategies to attack therapeutically solid tumors. Keeping in mind that there are factors, such as a physiological resistance to existing therapeutic agents, i.e. the environment in which a cell finds itself is exceedingly important."

"... Learning how to combine drugs in combination chemotherapy and knowing how to combine and deliver them more effectively than they have been in the past alone and in conjugation with surgery or radiation therapy. The major cause of failure of chemotherapy, whether we are treating with single or combination drugs, is the emergence of drug resistance. We must use non-cross resistant drugs to overcome this and match the dose intensities of each individual drug in order to limit the drug resistant cells, and eradicate the cells that are cancerous."

"Behavioral aspects of smoking cessation. Immune modulation research. It is related to biological response modifiers. Want to modify the immune system to treat cancer. I can think of neutron therapy and other particulate-atomic particle-therapy to treat cancer."

Verbatims II-2

THE MOST IMPORTANT FUNDAMENTAL QUESTION IN BASIC CANCER RESEARCH

Some Representative Quotes

Q.: As you know, advances in clinical medicine often result from fundamental advances in basic research. What do you think is the most important fundamental question which needs to be answered in order to achieve a major breakthrough in the treatment of cancer?

"What are the molecular mechanisms which cause cellular transformation from a normal cell to a cancer cell? And, which normal controls are still maintained in the cancer cell?"

"The control mechanisms in cell proliferation and differentiation."

"Why don't cancer cells mature and differentiate? That's the fundamental problem in cancer: Cancer cells don't grow up. Normal cells proliferate, then they mature, then they stop dividing, and then they die. Cancer cells are perpetual teenagers. They are always in growth. So, the fundamental question then is: Why do cancer cells continue to divide and fail to mature?"

"The mechanism for the heritable, i.e. the gene abnormality which is responsible for the transformation of cells so that they are not under control of normal growth factors. This is the area where virology, genetics and growth or cell differentiation come together. In addition, understanding the mechanisms of eliminating cells that are abnormal, i.e., the healthy host's resistance or tolerance of such abnormal cells if understood and exploited would be of great benefit."

"The aberration in molecular control mechanisms within cancer cells. I think that would afford us a better target. We need to target our research better. Knowing the molecular control mechanisms will help."

"I would emphasize fundamental science. The area I would emphasize has to do with the genetic controls of the self-renewing cell systems of the body, e.g., the skin, the lining of the airways, the lining of the bowel, the bone marrow. The reason is that I see various forms of cancer most commonly occurring in those self-renewing cell systems. I see cancer as a cartoon of those self-renewing cell systems in terms of cell maturation and differentiation. There is genetic instability in tumors, an inappropriate balance of genetic controls. They're out of balance. I would go for monoclonal growth abnormalities that seem to be pervasive in cancers. There are genetic abnormalities that we could use to characterize these disorders. My feeling is that they are very important early in the tumors and later during tumor proliferation. Oncogenes, for example, genes preserved throughout life, are important in cell growth and proliferation. In cancers there are mutations, amplifications of genes, deletions in some cancers, transpositions in others. You can even think of

(Continued)

Verbatims II-2 (Continued)

THE MOST IMPORTANT FUNDAMENTAL QUESTION IN BASIC CANCER RESEARCH

Some Representative Quotes

deletions of a gene in suppressing cancer. In the year 2000 I look forward to practical outcomes -- *detections of genotypic abnormalities* -- that will help define people at high risk. We would then also know the prognosis for certain tumors with some of the new information. For example, we'd know whether a tumor was of rapid growth, or slow growth. It will provide a more sensitive guide to therapy. Today we have difficulty knowing whether we have eradicated a tumor or not."

Verbatims II-3

PROGRESS AGAINST CANCER

Some Representative Quotes

Q.: In your opinion, is significant progress against cancer between now and the year 2000 more likely to come as the result of one central insight that helps control a number of different cancers, or slow, piecemeal progress on a disease-by-disease basis?

"Slow piecemeal progress, perhaps not on a disease-by-disease basis, but rather on a circumstance-by-cirmcumstance basis. It's possible that we will learn how a specific oncogene gets turned on and gets turned off. That particular oncogene might be responsible for a certain fraction of colon cancers, a different fraction of breast cancers, and a still different fraction of lung cancers. So the mechanism for turning off that one oncogene will apply where it is important, but that one oncogene may be responsible for more than one kind of cancer. Perhaps a complete reclassification of cancer [is needed] on the basis of the mechanics by which the specific cancer has developed. If several different causes are associated with the same apparent disease, and the specific mechanism of activation can be identifed for a particular cancer, [we will be able to] knock out the cancer, whatever the cause."

"Slow, piecemeal progress. I don't think there is any magic answer that will solve the whole problem. We need information on the controlling factors for cell division for each cell lineage."

"Slow, piecemeal progress. I think the history of research shows that advances are in a number of steps, such as the development of monoclonal antibodies. Getting to that point involved a number of slow steps forward. There is unlikely to be one startling breakthrough."

"Slow, piecemeal progress. The more we know about cancer the more complex it becomes. I think it is very unlikely that a single discovery of a single mechanism will be the silver bullet."

"What's happened in the last five years is that all the disciplines of cancer research have come together in one element - and that is oncogenes. There was a common element in all cancer research. This will continue to be true. Each cancer is almost like a separate viral disease so each one will have to be studied individually and progress will come in related families of cancers."

"Slow, piecemeal progress on a disease-by-disease basis clearly. That is what we are doing now. Each one is a different disease because it comes from a different tissue. It would be nice to have something common, but I don't see it happening."

(Continued)

Verbatims II-3 (Continued)

PROGRESS AGAINST CANCER

Some Representative Quotes

"Slow, piecemeal progress. That's the way progress has been made so far. Because cancer is many different diseases, I think one central insight that would be effective for all forms of cancer is unlikely. We will probably make progress in bladder cancer, head and neck cancer, and lung cancer -- by prevention. Progress will be made in terms of modifying the various treatments for individual diseases."

Table II-2

COMBATING CANCER IN THE YEAR 2000: BETTER PREVENTION, DIAGNOSIS, OR TREATMENT?

Base: Cancer scientists

Q.: Which do you think will do the most to combat cancer in the year 2000 -- better prevention, better diagnosis, or better treatment?

	Total
Base	40
Better prevention	25 63%
Better diagnosis	3 7%
Better treatment	9 23%
Not sure	2 5%
All play equal parts	1 2%

Table II-3

THE WAR ON CANCER: PREVENTION VS. TREATMENT

Base: Cancer scientists

Q.: In a recent paper in the "New England Journal of Medicine," Bailar and Smith wrote that, in effect, the war on cancer was being lost and that therefore we should start getting serious about prevention. On balance, how do you feel about their conclusion that cancer treatment is not getting a whole lot better? Do you agree strongly, agree somewhat, disagree somewhat, or disagree strongly?

Base:	40
Agree strongly	3 8%
Agree somewhat	11 28%
Disagree somewhat	9 23%
Disagree strongly	16 40%
Not sure	1 3%

Q.: What about their recommendation that scientists should concentrate much more on finding ways to prevent cancer rather than new means to treat it?

Base:	40
Agree strongly	6 15%
Agree somewhat	11 28%
Disagree somewhat	11 28%
Disagree strongly	7 18%
Need to concentrate on both	3 8%
Not sure	2 5%

Table II-4

PREVENTING CANCER: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Cancer scientists

Q.: I will read you a list of conditions. Please say for each one how much improvement you think we will make by the year 2000 in the prevention of this condition? Please use a scale of 0 to 10 where 0 is "no change" and 10 is "will be prevented entirely"

	Expected Degree of Improvement in Prevention					
	Rating Level on a Scale of 0 to 10					
Base: 40	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Lung cancer	5	16	6	11	2	7
	13%	40%	15%	28%	5%	
Cancer of the endometria and uterine cervix	4	13	8	9	6	6.5
	10%	33%	20%	23%	15%	
Liver cancer	6	8	8	15	3	5
	15%	20%	20%	38%	8%	
Stomach cancer	3	6	12	15	4	5
	8%	15%	30%	38%	10%	
Malignant melanoma	1	13	9	14	3	5
	3%	33%	23%	35%	8%	
Bladder cancer	1	8	9	9	2	5
	3%	28%	31%	31%	7%	
Colon and rectum cancer	1	11	12	14	2	5
	3%	28%	30%	35%	5%	
Head and neck cancer	1	9	12	13	5	5
	3%	23%	30%	33%	13%	
Breast cancer	1	8	10	19	2	4.5
	3%	20%	25%	48%	5%	
Kidney cancer	-	1	6	18	4	3
	-	3%	21%	62%	14%	

(Continued)

Table II-4 (Continued)

PREVENTING CANCER: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Cancer scientists

	Expected Degree of Improvement in Prevention					
	Rating Level on a Scale of 0 to 10					
Base: 40	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Prostate cancer	-	1	10	25	4	3
	-	3%	25%	63%	10%	
Non-Hodgkin's lymphoma	-	1	7	27	5	3
	-	3%	18%	68%	13%	
Pancreatic cancer	1	1	1	33	4	2
	3%	3%	3%	83%	10%	
Leukemia	-	4	6	28	2	2
	-	10%	15%	70%	5%	
Cancer of the ovaries	-	1	5	30	4	2
	-	3%	13%	75%	10%	
Brain cancer	-	-	5	30	5	2
	-	-	13%	75%	13%	

Table II-5

WAYS OF PREVENTING AND DIAGNOSING CANCER: EXPECTED FREQUENCY OF USE IN THE YEAR 2000

Base: Cancer Scientists

Q.: I will read a list of current and future ways of preventing or diagnosing cancer. Would you please say for each one whether in the year 2000 it will be much more widely used than it is today, somewhat more widely used, less widely used, or whether it will scarcely be used at all.

Base: 40	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Smoking prevention and cessation	28 70%	9 23%	1 3%	1 3%	1 3%	- -
Imaging techniques like PET and MRI	26 65%	12 31%	- -	- -	- -	1 3%
Tests based on monoclonal antibodies	23 58%	13 33%	1 3%	- -	2 5%	1 3%
Genetic markers for susceptibility to cancer	23 58%	11 28%	1 3%	- -	4 10%	1 3%
Reducing environmental carcinogens	16 40%	18 45%	3 8%	2 5%	1 3%	- -
Mammography	16 40%	14 35%	4 10%	3 8%	1 3%	2 5%
Nutrition	14 35%	18 45%	2 5%	2 5%	2 5%	2 5%
Self-examination of breasts	14 35%	15 38%	9 23%	1 3%	1 3%	- -
Early detection of occult bleeding	9 23%	19 48%	10 25%	1 3%	1 3%	- -
Periodic gyn exams and tests	9 23%	15 38%	14 35%	1 3%	- -	1 3%
Periodic rectal exams	5 13%	16 40%	17 43%	- -	2 5%	- -
Periodic ultrasound exams	3 8%	13 33%	9 23%	8 20%	2 5%	5 13%

Table II-6

WILL WE HAVE A CANCER VACCINE BY THE YEAR 2000?

Base: Cancer scientists

Q.: Will it be possible by the year 2000 to vaccinate people directly against certain types of cancer?

	Total
Base	40
Will be possible	24 60%
Will not be possible	13 33%
Not sure	3 8%

Table II-7

TREATING CANCER: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Cancer scientists

Q.: I will read you a list of conditions. Please say for each one how much of a change you think we will make by the year 2000 in the treatment of this condition where 0 is "no change" and 10 is "will have a total and complete cure" by the year 2000.

	Expected Degree of Improvement in Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 40	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Leukemia	7	19	8	2	4	7.5
	18%	49%	21%	5%	10%	
Non-Hodgkin's lymphoma	4	17	12	2	5	7
	10%	43%	30%	5%	13%	
Breast cancer	2	13	13	8	4	6
	5%	33%	33%	20%	10%	
Cancer of the endometrial and uterine cervix	3	9	12	10	6	5
	8%	23%	30%	25%	15%	
Prostate cancer	2	9	8	16	5	5
	5%	23%	20%	40%	13%	
Cancer of the ovaries	1	11	11	12	5	5
	3%	28%	28%	30%	13%	
Malignant melanoma	1	8	15	12	4	5
	3%	20%	38%	30%	10%	
Bladder cancer	1	5	10	7	7	5
	3%	17%	33%	23%	23%	
Colon and rectum cancer	1	5	19	10	5	5
	3%	13%	48%	25%	13%	
Head and neck cancer	1	5	12	16	6	5
	3%	13%	30%	40%	15%	
Kidney cancer	1	3	10	8	7	5
	3%	10%	34%	28%	24%	

(Continued)

Table II-7 (Continued)

TREATING CANCER: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Cancer scientists

	Expected Degree of Improvement in Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 40	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Stomach cancer	2	2	9	22	5	4
	5%	5%	23%	55%	13%	
Lung cancer	-	2	14	20	4	4
	-	5%	35%	50%	10%	
Liver cancer	-	4	6	26	4	3
	-	10%	15%	65%	10%	
Brain cancer	-	1	10	23	6	3
	-	3%	25%	58%	15%	
Pancreatic cancer	-	-	4	31	5	2
	-	-	10%	78%	13%	

Verbatims II-4

BIGGEST ADVANCE IN THE PREVENTION OR TREATMENT OF LUNG CANCER BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for lung cancer, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"If the world stops smoking. Other factors are trivial."

"It will be prevention. I think that you can continue to affect the incidence of the disease by reducing the level of smoking. But, treatments, I anticipate will not produce cures, but will increase the length of remission."

"The biggest advance is in prevention, and it will be by increasing public awareness that smoking is definitely the cause of this disease. So, I think a reduction of cigarette smoking and more vigorous control of public exposure to cigarette smoking."

"It won't be in treatment, it will be in prevention. We will [be able to] identify the risk group affected by the major carcinogens by means of genetic control."

"The elimination of cigarette smoking or the elimination of the causative agent of cancer from cigarette smoking."

"Smokeless society--approaching a smoke-free society. It is much easier to prevent it than to treat it."

"Biggest advance should be stopping smoking. That would have the biggest impact"

"Prevention would be stopping smoking. With regard to treatment: improved delivery of combination drugs would be the biggest advance in treatment."

"Reduction of smoking but also identifying the genes involved and determination if there's a susceptibility."

"The advances will depend on the ability to persuade people not to smoke. I think that by the year 2000 the incidence of lung cancer will not have decreased substantially in men. It appears to be increasing in women. We are not making progress in the treatment of lung cancer. The biggest advance would be the refusal of non-smokers to tolerate smokers, i.e. to tolerate association with people who are smoking. The answer is social pressure from non-smokers."

Verbatims II-5

LIFE STYLE CHANGES AND CANCER

Some Representative Quotes

Q.: What one change in life style would do most to reduce the incidence and severity of cancer?

"Cessation of smoking: 30% of all cancer deaths are due to smoking, there is no other single cause that is anywhere near that."

"Changes in diet and smoking: smoking would be first, then reduce sunlight second for skin cancer. In diet - I think the critical one is reducing fat."

"Cessation of smoking. No question about it, unequivocal."

"It has to be prevention of smoking. Smoking already accounts for one-third of your cancer burden. It is going to take a while to slow it up, but it would be the best thing that could be done."

"One single change is required - complete elimination of smoking is the goal. When 25,000 doctors in UK were followed over 15 years - the rate at which smoking was given up correlated exactly with a dramatic rate of fall in death from lung cancer."

"Reduce the intake of fat in diet and, of course, less smoking."

"Smoking first, and a reduction in obesity. The other is reduction of sexual promiscuity. There is evidence that cervical cancer is related to papilloma viruses, hepatomas are related to hepatitis viruses which can be transmitted sexually, and AIDS -- for example, Kaposi's sarcoma - is caused by sexually transmitted viruses."

Verbatims II-6

THE BIGGEST ADVANCE IN THE PREVENTION OR TREATMENT OF BREAST CANCER BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for breast cancer, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"Low fat plus or minus other things added to the diet. Anti-promoters. Cancer is caused by cells being initiated. But not all cells that are initiated go on to develop cancer. The cell must be exposed to a promoter. We think that we can interfere with the promoter stage called the antipromoter."

"For prevention it is hormonal treatment and for treatment it is early detection."

"Better diet. Lower daily fat intake. In general, Americans get about 30% of their calories by way of fat, whereas Japanese people get about 15% by way of fat. Their incidence of breast cancer is very low, ours is very high. So by reducing the overall fat intake, we ought to be able to make a major impact on the incidence of cancer."

"Early detection and better treatment of early disease. I think that we will still have problems with mortality and advanced disease in the year 2000. But more advancement will be made in the early detection and in the better treatment of early disease."

"Predictions or who is likely to get metastatic disease and who isn't in the people with localized and regional breast cancer. Then, fine tuning current approaches, and adding to some of the newer ideas like antibody-linked RICIN. A biochemical measurement of the expression of the phenotype for patients with poorly differentiated or pleomorphic nuclei would tell us which patients would have a high likelihood of having the disease spread. We'll be able to measure the likelihood of metastasis, instead of just looking at the condition as it is or inferring from it."

"I think it will be a treatment in improving adjutant chemotherapy, i.e., surgery plus chemotherapy. Removing the major mass of the tumor cells in the breast and then optimally delivering combination chemotherapy."

Table II-8

ESTIMATED CURE RATE FOR CANCER IN THE YEAR 2000

Base: Cancer scientists

Q.: The National Cancer Institute estimates that the average cure rate for cancer patients of all types is about 50%. What do you think it will be in the year 2000?

	Total
Base	40
50%	1 3%
55%	3 8%
57%	1 3%
60%	12 30%
65%	5 13%
67%	1 3%
70%	3 8%
75%	8 20%
80%	3 8%
90%	1 3%
Mean	67%
Median	65%
Don't know/no answer	2 5%

Table II-9

WAYS OF TREATING CANCER: EXPECTED FREQUENCY OF USE IN THE YEAR 2000

Base: Cancer scientists

Q.: I will read a list of current and future ways of treating cancer. Would you please say for each one whether in the year 2000 it will be much more widely used than it is today, somewhat more widely used, less widely used or whether it will scarcely be used at all.

Base: 40	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Monoclonal and polyclonal antibodies	18 45%	14 35%	2 5%	1 3%	2 5%	3 8%
Drug-antibody conjugations	17 43%	17 43%	- -	1 3%	1 3%	3 8%
Bone marrow transplants	15 38%	17 43%	3 8%	2 5%	1 3%	2 5%
Novel lymphokines and cytokines	11 28%	13 33%	- -	- -	1 3%	4 10%
Interleukens	9 23%	13 33%	- -	1 3%	3 8%	3 8%
Nutrition	8 20%	11 28%	8 20%	3 8%	5 13%	5 13%
Cytotoxic drugs	3 8%	14 35%	10 25%	12 30%	- -	1 3%
Psychologic measures to enhance immume response	3 8%	5 13%	8 20%	5 13%	17 43%	2 5%
Higher linear energy transfer	2 5%	17 43%	8 20%	5 13%	- -	7 18%
Interferon	2 5%	10 25%	5 13%	7 18%	3 8%	2 5%
Hyperthermia	2 5%	6 15%	5 13%	18 45%	4 10%	5 13%
Surgery	1 3%	6 15%	22 55%	9 23%	1 3%	1 3%
Traditional radiation	- -	3 8%	24 60%	11 28%	1 3%	1 3%

Verbatims II-7

THE MOST IMPORTANT COMPLETELY NEW TYPES OF THERAPY FOR CANCER IN THE YEAR 2000

Some Representative Quotes

Q: By the year 2000, what do you think will be the two or three most important, completely new types of therapy for cancer which are not available now?

"Redifferentiation agents and some genetic manipulation techniques. Also targeting monoclonal antibodies to cellular factory. Couple that to the two I mentioned and you'll have a really powerful tool."

"Difference causing agents. I think we will develop antimetastatic agents. It is clear we will develop more efficacious carriers for drugs like monoclonal antibodies."

"Differentiation therapy, making cells develop into mature cells, so they are no longer malignant. This would include biological response modifiers, e.g. bloodforming factors needed for the development of blood cells. These differentiation agents might be proteins made by various types of cells which are needed for differentiation of bloodforming cells. Inactivation of particular enzymes which may make a cell malignant. This could be by inhibitors of the enzymatic activities which make the cell malignant. Inhibitors which may have a specificity for enzymatic activity found only in tumor cells, not in normal cells."

"Biological response modifiers, e.g. lymphokines, cytokines, interleukins, etc. Growth and differentiation factors for granulocytes, B cells, T cells, Hematopoietic growth and differentiation agents."

"1. Monoclonal antibody directed treatments - these would be monoclonal antibodies which would be targeted to tumors and which either bring poisons like radioactive materials, with them, or would be cytotoxins themselves.
2. Specific radiation sensitizers - these are agents which would sensitize tumors, but not normal tissue to radiation.
3. Differentiation agents - they're what make cells grow-up, i.e. to mature and stop dividing."

"1. Anti-angiogenesis - Angiogenesis is a process whereby a blood supply is commanded by a tumor. If we can find drugs that will prevent that, it will give us essentially a non-toxic way of treating cancer.
2. Biological response modifiers, for example, Interferon, Interleukin II, TNF: Tumor Necrosis Factor.
3. Maturation drugs-differentiation agents."

"1. Monoclonal antibodies directed against the biochemical products of oncogenes.
2. Selective, specific, targeted cytotoxic agents.
3. Anti-cell proliferation drugs."

(Continued)

Verbatims II-7 (Continued)

THE MOST IMPORTANT COMPLETELY NEW TYPES OF THERAPY FOR CANCER IN THE YEAR 2000

Some Representative Quotes

"There are four approaches to attack cancer:
1. Go after the stimulus for growth.
2. Go after the oncogene products.
3. Go after the cancer cell itself.
4. Growth controlling agents."

"1. Growth factor inhibition.
2. The means to ameliorate drug resistance, i.e. we'll learn how to overcome drug resistance. This will probably entail inhibitors of the cellular proteins responsible for defense of the cell against these drugs, i.e. for drug resistance.
3. Differentiation agents.
4. Targeting drugs by using monoclonal antibodies against some oncogene product which is associated with the tumor. Thus we can send the drug to appropriately primed sites."

Table II-10

HOW COMMON ARE HUMAN TUMOR VIRUSES?

Base: Cancer scientists

Q.: Although many viruses are known in animals, only a few have been established in human beings -- the HTLV or LAV viruses, for example. When all the facts are known, do you expect that human tumor viruses will turn out to be much more common than is now thought, slightly more common, or not any more common than the few we know today?

	Total
Base	40
Much more common	9 23%
Slightly more common	24 60%
Not any more common	7 18%
Not sure	- -

CHAPTER III: CARDIOVASCULAR DISEASE: LOOKING AHEAD TO THE YEAR 2000

CARDIOVASCULAR RESEARCH

Most Promising Areas of Cardiovascular Research

The most promising areas of cardiovascular research are seen to be clot dissolving drugs and less-invasive diagnostic therapeutic techniques such as balloon angioplasty and other catheter-based techniques (Table III-1). Four other areas which receive high ratings all deal with basic research on heart attacks, atherosclerosis, clot formation and lipid metabolisms. Research on the artificial heart received among the poorest ratings and was not considered very promising.

The Most Fundamental Question in Basic Cardiovascular Research

The study of atherosclerosis offers the most promise (Verbatims III-1). The fundamental question in cardiovascular research is understanding early stages and causes of atherosclerosis -- a degenerative disease of the arteries that is characterized by the deposit of fatty substances resulting in the narrowing of the passages of the blood vessels, ultimately resulting in hardening of the arteries and loss of elasticity.

THE PREVENTION, DIAGNOSIS AND TREATMENT OF CARDIOVASCULAR DISEASE

Will Better Prevention, Better Diagnosis, or Better Treatment Do Most to Combat Cardiovascular Disease in the Year 2000?

Fully 90% of the researchers predict that better prevention will do more than either treatment or diagnosis to combat cardiovascular disease (Table III-2).

THE PREVENTION AND DIAGNOSIS OF CARDIOVASCULAR DISEASE

Degree of Improvement Expected in the Prevention of Cardiovascular Diseases by the Year 2000

Cardiovascular researchers are not optimistic about improving the prevention of major cardiovascular diseases. The conditions for which a majority expect "some improvement" are strokes, thromboembolisms (blocking of a vessel by a blood clot) and myocardial infarction (heart attack) (Table III-3).

Progress in Predicting Heart Attacks and Strokes

Researchers are optimistic about their ability to predict heart attacks and strokes. Eighty-one percent see significant progress in predicting heart attacks (Table III-4), 62% in predicting strokes (Table III-5). These data support predicted improvements in the prevention of heart attacks and strokes seen in Table III-3.

Elaborating freely on what type of progress will be made in predicting heart attacks and strokes, the leading response was the identification of risk factors, followed closely by the identification of genetic markers and the development of non-invasive diagnostic techniques (Verbatims III-2 and III-3).

Methods of Preventing and Diagnosing Cardiovascular Disease: How Widely They Will Be Used in the Year 2000

The researchers expect life style modifications such as exercise, smoking and nutrition, to be more widely adopted in the year 2000 (Table III-6). They also predict wider use of techniques such as clot-preventing drugs, genetic markers to screen for susceptibility to cardiovascular disease, heart imaging techniques, and plaque-preventing drugs.

The Role of Life Style Changes in Reducing the Severity and Incidence of Cardiovascular Diseases: Dietary changes, such as reduced intake of fat, sodium, cholesterol, and calories in general; reduced smoking; and increased exercise or physical activity are seen as the life style changes which will do most to reduce the incidence and severity of cardiovascular diseases (Verbatims III-4).

THE TREATMENT OF CARDIOVASCULAR DISEASE

Degree of Improvement Expected in the Treatment of Cardiovascular Disease by the Year 2000

Researchers see the greatest improvement in the treatment of hypertension (Table III-7). Improvement is also seen in the treatment of thromboembolisms, cardiac arrhythmias, myocardial infarctions, atherosclerosis, and congestive heart failure. Over 50% of the researchers expect at least a moderate degree of improvement in the treatment of these conditions by the year 2000. In contrast, about 50% of the specialists predict no change in the treatment of cardiomyopathies (diseases affecting the heart muscles) and congenital heart malformations.

Heart Attacks and Stroke: Many reseachers believe that the biggest advances in the prevention or treatment of heart attacks lie in changes of life style, such as a reduction of smoking and changing dietary habits. They also look to a clearer understanding of the underlying causes of cardiovascular disease (Verbatims III-5).

For strokes, treating and controlling hypertension and the prevention of atherosclerosis are seen by many researchers as the most important advances (Verbatims III-6).

Methods of Treating Cardiovascular Disease: Extent of Use in the Year 2000

Heart Transplants vs. a Mechanical Heart: Heart transplants are expected to be in far wider use than mechanical hearts. Eighty-six percent project wider use of transplants (Table III-8) and 90% predict that a heart transplant will be the preferred therapy in the year 2000, even assuming that both were to be equally available (Table III-9). The preference for a heart transplant appears to stem from reservations about developing a real mechanical substitute for the heart. As indicated by the data in Table III-10, 62% of the scientists do not expect a mechanical substitute to be available by the year 2000.

Cardiothoracic Surgery vs. Catheter-Based Procedures: Cardiothoracic and bypass surgery are expected to be less widely used in the year 2000 by 43% and 48% of the researchers, respectively (Table III-8). In contrast, 95% of the researchers predict that balloon angioplasty and other less invasive catheter-based techniques will be used more widely in the year 2000.

The Use of Drug Therapies for Cardiovascular Disease: The third important finding in Table III-8 concerns the use of drug therapies. The majority of researchers expect all drug therapies to be more widely used by the year 2000. Ninety-six percent say clot-dissolving drugs will be used more often, 86% expect greater use of anti-arrhythmia drugs, 76% see more use of plaque-dissolving drugs and 86% say there will be greater use of drugs to minimize damage to the heart muscle after a heart attack.

Table III-1

CARDIOVASCULAR DISEASES: MOST PROMISING AREAS OF RESEARCH

Base: Cardiovascular scientists

Q.: I will read you a short list of some of the major areas of cardiovascular research. Please say for each one how promising you think it is on a scale of 0 to 10 where 0 is "not promising at all" and where 10 is "most promising one could imagine".

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 21	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Clot-dissolving drugs	9	8	4	-	-	8
	43%	38%	19%	-	-	
Balloon angioplasty and other catheter-based techniques	8	10	3	-	-	8
	38%	48%	14%	-	-	
Basic mechanism of heart attacks	6	10	4	1	-	8
	29%	48%	19%	5%	-	
Molecular mechanisms of lipid metabolisms and transport	6	8	5	2	-	8
	29%	38%	24%	10%	-	
Molecular mechanisms of atherosclerosis	6	8	5	2	-	8
	29%	38%	24%	10%	-	
Less invasive and risky diagnostic techniques	5	12	2	2	-	8
	24%	57%	10%	10%	-	
Molecular mechanisms of clot formation	4	12	4	1	-	8
	19%	57%	19%	5%	-	
Plaque preventing drugs	7	7	1	6	-	7
	33%	33%	5%	29%	-	
Heart imaging techniques	5	8	7	1	-	7
	24%	38%	33%	5%	-	
Better drugs to reduce high blood pressure	4	7	8	2	-	7
	19%	33%	38%	10%	-	

(Continued)

Table III-1 (Continued)

CARDIOVASCULAR DISEASES: MOST PROMISING AREAS OF RESEARCH

Base: Cardiovascular scientists

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 21	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Implantable devices such as the automatic defibrillator	2 10%	10 48%	4 19%	4 19%	1 5%	7
Nutritional guidelines to prevent heart disease	4 19%	6 29%	5 24%	6 29%	- -	6
Plaque-dissolving drugs	3 14%	5 24%	6 29%	7 33%	- -	6
Heart transplants	2 10%	8 38%	5 24%	6 29%	- -	6
Improved electrophysiological testing of the heart	- -	9 43%	6 29%	5 24%	1 5%	6
Improvements in continuous heart monitoring	3 14%	6 29%	6 29%	5 24%	1 5%	5.5
Better drugs to minimize damage to heart muscle after a heart attack	4 19%	2 10%	8 38%	7 33%	- -	5
New surgeries to repair congenital defects	2 10%	3 14%	4 19%	12 57%	- -	4
Drugs to minimize damage to nerve cells after a stroke	1 5%	5 24%	3 14%	11 52%	1 5%	4
Artificial heart	- -	2 10%	8 38%	11 52%	4 5%	

Verbatims III-1

THE MOST IMPORTANT FUNDAMENTAL QUESTION IN BASIC CARDIOVASCULAR RESEARCH

Some Representative Quotes

Q.: As you know, advances in clinical medicine often result from fundamental advances in basic research. What do you think is the most important fundamental question which needs to be answered in order to achieve a major breakthrough in the treatment of cardiovascular disease?

"Basic mechanisms of the early stages of atherosclerosis need to be worked out. If you could understand that then you could prevent heart disease and secondarily prevent the acute effects of the heart attack. We must first learn exactly what stimulates the smooth muscle to grow in the atherosclerosis process."

"I think it would be a detailed understanding of the pathogenesis of atherosclerosis. Today we are just taking advantage of a little bit of information by decreasing cholesterol and trying to increase high density lipoproteins. If we understand much better the molecular mechanisms, we would be much better at prevention and treatment. I'm not convinced simply decreasing cholesterol is the answer."

"The factors that lead to development of atherosclerotic disease: diet, smoking, stress, activity and how to influence the population to make the required adjustments in these areas."

"A crucial question that we must answer is the mechanism of conversion from chronic to acute disease in ischemia. With myocardial infarction and stroke, what triggers the change from baseline cardiovascular disease to the actual event. Understanding when and in whom this will happen."

"The molecular mechanism of heart failure. We know a fair amount about atherosclerosis and what the mechanism of damage is. Research is gradually accruing. The same with hypertension. Heart failure is completely not understood. We need to answer the fundamental question of heart failures' molecular mechanisms before good treatments will come."

"The question is what leads to progression of heart muscle disease once the heart muscle has been overloaded or damaged. It is a vicious circle after damage or strain -- once the load is removed the heart muscle dysfunction progresses producing another load. This is the most important cause of cardiovascular mortality."

"Understanding of what controls levels of high density lipoproteins (HDL). This is the most powerful risk factor for heart disease and we still don't understand production or clearance of HDL in [the] blood. At [the] present time our measurements are rudimentary."

Table III-2

COMBATING CARDIOVASCULAR DISEASES IN THE YEAR 2000: BETTER PREVENTION, DIAGNOSIS, OR TREATMENT?

Base: Cardiovascular scientists

Q.: Which do you think will do the most to combat cardiovascular diseases in the year 2000 -- better prevention, better diagnosis, or better treatment?

	Total
Base	21
Better prevention	19 90%
Better diagnosis	- -
Better treatment	1 5%
Not sure	- -
All equal	1 5%

Table III-3

PREVENTING CARDIOVASCULAR DISEASES:
EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Cardiovascular scientists

Q.: I will read you a list of conditions. Please say for each one how much of an improvement you think we will make by the year 2000 in the prevention of these conditions? Please use a scale of 0 to 10 where 0 is "no change" and 10 is "will be prevented entirely".

	Expected Degree of Improvement in Prevention					
	Rating Level on a Scale of 0 to 10					
Base: 21	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Stroke	1	12	6	2	-	7
	5%	57%	29%	10%	-	
Thromboembolism	-	12	6	3	-	7
	-	57%	29%	14%	-	
Myocardial infarction	-	11	6	4	-	7
	-	52%	29%	19%	-	
Hypertension	1	9	5	6	-	6
	5%	43%	24%	29%	-	
Coronary artery disease	-	8	8	5	-	6
	-	38%	38%	24%	-	
Cardiac arrhythmias	-	7	10	3	1	5.5
	-	33%	48%	14%	5%	
Sudden cardiac death	-	6	8	6	1	5.5
	-	29%	38%	29%	5%	
Congestive heart failure	1	8	6	5	1	5
	5%	38%	29%	24%	5%	
Valvular heart disease	1	5	6	8	1	5
	5%	24%	29%	38%	5%	
Shock	1	4	6	8	2	5
	5%	19%	29%	38%	10%	
Atherosclerosis	-	7	8	6	-	5
	-	33%	38%	29%	-	
Cardiomyopathies	-	3	5	12	1	4
	-	14%	24%	57%	5%	
Congenital heart malformations	1	-	3	16	1	3
	5%	-	14%	76%	5%	

Table III-4

EXPECTED PROGRESS IN PREDICTING A HEART ATTACK

Base: Cardiovascular scientists

Q.: How much progress do you see in our ability to tell who is likely to suffer from a heart attack and when this may happen -- a great deal, quite a lot, not much, or none at all?

	Total
Base	21
A great deal	8 38%
Quite a lot	9 43%
Not much	4 19%
None at all	- -
Not sure	- -

Table III-5

EXPECTED PROGRESS IN PREDICTING A STROKE

Base: Cardiovascular scientists

Q.: How much progress do you see between now and the end of the century in our ability to tell who is likely to suffer from a stroke and when this may happen -- a great deal, quite a lot, not much, or not at all?

	Total
Base	21
A great deal	6 29%
Quite a lot	7 33%
Not much	8 38%
None at all	- -
Not sure	- -

Verbatims III-2 and III-3

PROGRESS IN PREDICTING HEART ATTACKS AND STROKES

Some Representative Quotes

Q.: What do you think that progress will be? (heart attacks)

Q.: What do you think that progress will be? (strokes)

Heart attacks
"I think it will be the identification of patients by virtue of knowledge of their genetic background. Another is probably under polygenic control. Given background, predictions could be calculated on a probability basis."
Strokes
"Similar to what I said for heart attacks. And for both, better diagnostic techniques and imaging techniques."

Heart attacks
"Better understanding of markers and elements which would allow us to forecast increased risk. We need to identify factors besides those currently recognized: smoking, high blood pressure and cholesterol levels."
Strokes
"Identifying genetic markers and endogenous factors that would identify people at risk."

Heart attacks
"Identifying genetic susceptibility, genetic typing. For example, knowledge of more of the genetic factors which predispose to eventual hypertension and heart attack. The same is true for high serum cholesterol. For example, the genetic susceptibility of such people."

Heart attacks
"We are about to launch a 'crusade on cholesterol,' which will implement wide scale screening of our population for blood cholesterol levels, akin to the hypertension screening programs begun in the 60s and 70s."

Heart attacks
"Two kinds of progress. One, genetic markers to use in predicting those who are at higher risk. Two, non-invasive imaging techniques for visualizing the coronary vessels and following those individuals who are at risk."
Strokes
"The same things I've just said for predicting heart attacks."

(Continued)

Verbatims III-2 and III-3 (Continued)

PROGRESS IN PREDICTING HEART ATTACKS AND STROKES

Some Representative Quotes

Strokes
"Detection of Type A behavior, just as it will allow us to identify those at risk for heart attack, will allow us to identify those at risk for stroke and allow us to institute measures in time."

Strokes
"Understanding lipoproteins and their role in vascular disease. Better study of hypertension and better control of blood pressure. Better imaging techniques for cerebrovascular disease."

Strokes
"Identification of those susceptible to strokes enabling early intervention and prevention."

Table III-6

WAYS OF PREVENTING AND DIAGNOSING CARDIOVASCULAR DISEASES

Base: Cardiovascular scientists

Q.: I will read a list of current or future ways of preventing or diagnosing cardiovascular diseases. Would you please say for each one whether in the year 2000 it will be much more widely used than it is today, somewhat more widely used, less widely used, or whether it will scarcely be used at all.

Base: 21	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Life style modifications, including things such as exercise, smoking and nutrition	16 76%	5 24%	- -	- -	- -	- -
Clot-preventing drugs	13 62%	5 24%	2 10%	- -	1 5%	- -
Genetic markers to screen for susceptibility to cardiovascular disease	13 62%	5 24%	1 5%	1 5%	1 5%	- -
Heart imaging techniques	12 57%	9 43%	- -	- -	- -	- -
Plaque-preventing drugs	11 52%	6 29%	2 10%	2 10%	- -	- -
Electrophysiological testing of the heart	4 19%	9 43%	4 19%	3 14%	1 5%	- -
Stress tests	3 14%	10 48%	2 10%	6 29%	- -	- -
Continuous heart monitoring	3 14%	8 38%	8 38%	2 10%	- -	- -
Stress reduction techniques	2 10%	4 19%	5 24%	3 14%	6 29%	1 5%

Verbatims III-4

LIFE STYLE CHANGES AND CARDIOVASCULAR DISEASE

Some Representative Quotes

Q.: What changes in life style, if any, would do most to reduce the incidence and severity of cardiovascular diseases?

"Cessation of smoking would do an enormous amount to decrease the incidence of cardiovascular disease. People need to stop smoking."

"I would stress stop smoking and eating in moderation. Smoking is an important risk factor. Reducing intake of certain types of food. Early treatment of hypertension is also important. I'm concerned that exercise is not a major factor. I think American physicians and cardiologists are faddists; jumping on the bandwagon in the absence of good, hard evidence. Also excellent control of diabetes."

"Stop eating. I'm only partly facetious, but the Duchess of Windsor once said, "Malnutrition is good for the heart." Americans are too fat. A 20% reduction in caloric intake across the board would be reasonable."

"Diet, exercise -- cardiovascular exercise, aerobic exercise -- and stopping smoking."

"Mostly limiting fatty acids in diet to half their current levels. Also, an increase in exercise and physical activity. And getting rid of cigarettes."

"1. Reduction of smoking.
2. Dietary changes to reduce blood cholesterol.
3. Increased exercise."

"1. Exercise.
2. Diet: reduce lipids and sodium."

"1. Decrease in smoking.
2. Exercise."

"1. Decrease smoking.
2. Exercise.
3. Dietary changes."

"In decreasing order of importance: cigarette abstention, improved diet, hypertension control, increased physical activity, better weight control, improved psychological habits."

Table III-7

TREATING CARDIOVASCULAR DISEASES: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Cardiovascular scientists

Q.: I will read you a list of conditions. Please say for each one how much of a change we will have made in the treatment of the condition, where 0 is "no change" and 10 is "will have a total and complete cure by the year 2000."

	Expected Degree of Improvement in Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 21	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Hypertension	4	11	5	1	-	7
	19%	52%	24%	5%	-	
Thromboembolism	2	11	7	1	-	7
	10%	52%	33%	5%	-	
Cardiac arrhythmias	2	11	5	2	1	7
	10%	52%	24%	10%	5%	
Myocardial infarction	1	11	8	1	-	7
	5%	52%	38%	5%	-	
Atherosclerosis	1	10	9	6	-	7
	5%	48%	14%	29%	-	
Congestive heart failure	-	11	5	4	1	7
	-	52%	24%	19%	5%	
Coronary artery disease	-	10	8	3	-	6
	-	48%	38%	14%	-	
Stroke	-	8	6	7	-	6
	-	38%	29%	33%	-	
Valvular heart disease	1	8	2	9	1	5.5
	5%	38%	10%	43%	5%	
Sudden cardiac death	-	6	7	7	1	5.5
	-	29%	33%	33%	5%	
Shock	1	6	6	6	2	5
	5%	29%	29%	29%	10%	
Cardiomyopathies	-	3	7	10	1	4.5
	-	14%	33%	48%	5%	
Congenital heart malformations	-	5	4	11	1	4
	-	24%	19%	52%	5%	

Verbatims III-5

BIGGEST ADVANCE IN PREVENTING OR TREATING HEART ATTACKS BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for heart attacks, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"Dramatic advances will come in therapy. An array of therapies will be available that will turn off a heart attack -- thrombolytic therapy and other drugs to turn off [the] infarction process, such as the superoxide dismutase type drugs. Also, possibly, Beta blockers to turn off the adrenergic system. Also need to turn off the phospholipids. These therapies, however, will need to be instituted immediately after the event. Getting patients to centers in time will be a major problem. Seattle has initiated a helicopter ambulance program which may provide a model for the future."

"In terms of prevention, the mechanism of the underlying disease will become clearer, leading to a decreased prevalence of atherosclerosis. Treatment will be improved with better thrombolytic therapy and better invasive procedures, but the importance of early treatment cannot be overemphasized."

"Reduction in smoking. Despite the smoking propaganda, I think it will be reduced but it will be frustrating that it is not further reduced. It is one of the outstanding risk factors which dominates along with age and diet and it is one that can be limited."

"Prevention of clot formation in the coronary arteries through a better understanding of what precipitates the clot. Then drugs will be able to be refined to fight this problem. The year 2000 is an optimistic time frame for this knowledge."

"Modification of Type A behavior. People's attitudes to deal with impatience and hostilities may begin to have an impact on the prevention of heart attacks. If we can modify the behavior, we can prevent the consequences."

"It will not be an understanding of the disease [heart]. The major advance will come if people stop smoking -- then the incidence of heart attacks will go down; whether we understand how it works or not."

"Identification of susceptible individuals by means of genetic markers. This will allow us to intervene before the heart attack with drug therapies and prevent the consequences of acute infarction."

Verbatims III-6

BIGGEST ADVANCE IN PREVENTING OR TREATING STROKES BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for strokes, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"Prevention will be the key to strokes. First we need to understand the mechanism -- a possible nutritional factor which is causative. It will also be necessary to better control hypertension. These will result in a decreased incidence of stroke."

"Control of high blood pressure through better drugs and more importantly through increased compliance to therapy. This could make great strides in the prevention of stroke."

"Prevention is the key. The big advance will come with prevention of atherosclerosis. To achieve this we must prevent smoking. Smoking must be outlawed."

"The biggest advance will come in finding a better antiplatelet drug than aspirin that will be useful in preventing strokes. Platelets play a major role in stroke and a better agent needs to be perfected."

"Modification of Type A behavior. The modification of this behavior will be a major advance toward pressure and other associated factors, but much more needs to be done."

Table III-8

WAYS OF TREATING CARDIOVASCULAR DISEASES: EXPECTED FREQUENCY OF USE IN THE YEAR 2000

Base: Cardiovascular scientists

Q.: I will read a list of current or future ways of treating cardiovascular diseases. Would you please say for each one whether in the year 2000 it will be much more widely used than it is today, somewhat more widely used, less widely used, or whether it will scarcely be used at all.

Base: 21	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Clot-dissolving drugs	14 67%	6 29%	1 5%	- -	- -	- -
Heart transplants	12 57%	6 29%	2 10%	1 5%	- -	- -
Anti-arrhythmia drugs	12 57%	6 29%	2 10%	1 5%	- -	- -
Plaque-dissolving drugs	11 52%	5 24%	- -	1 5%	4 19%	- -
Drugs to minimize the damage to heart muscle after a heart attack	10 48%	8 38%	2 10%	- -	1 5%	- -
Balloon angioplasty and other catheter-based techniques	9 43%	11 52%	- -	1 5%	- -	- -
Implantable automatic defibrillator	9 43%	8 38%	- -	1 5%	1 5%	2 10%
Prenatal surgery for congenital defects	1 5%	12 57%	- -	2 10%	3 14%	3 14%
Cardiothoracic surgery in general	- -	5 24%	7 33%	9 43%	- -	- -
Bypass surgery	- -	6 29%	5 24%	10 48%	- -	- -
Mechanical heart	- -	13 62%	2 10%	3 14%	3 14%	- -

Table III-9

PREFERRED THERAPY IN THE YEAR 2000: HEART TRANSPLANT OR ARTIFICIAL HEART?

Base: Cardiovascular scientists

Q.: In the year 2000, which do you think will be the preferred therapy, assuming that both were equally available -- a heart transplant or an artificial heart?

	Total
Base	21
Heart transplant	19 90%
Artificial heart	2 10%
Not sure	- -

Table III-10

WILL WE HAVE A "REAL" MECHANICAL SUBSTITUTE FOR THE HEART BY THE YEAR 2000?

Base: Cardiovascular scientists

Q.: By the year 2000, do you expect a mechanical device to be developed that can really serve as a substitute for the heart?

	Total
Base	21
Expect	8 38%
Do not expect	13 62%
Not sure	- -

Table III-11

CORONARY BYPASS SURGERY: FREQUENCY OF USE IN THE YEAR 2000

Base: Cardiovascular scientists

Q.: Some 70,000 coronary bypass operations are performed in the United States annually. If these patients were being treated in the year 2000, what percentage of these would be treated with bypass surgery, what percentage with catheter-based procedures, and what percentage with other therapies?

	Mean
Base: 20	
Bypass surgery	30%
Catheter-based procedures	45%
Other therapies	25%

CHAPTER IV: THE CENTRAL NERVOUS SYSTEM: LOOKING AHEAD TO THE YEAR 2000

RESEARCH ON THE CENTRAL NERVOUS SYSTEM

Most Promising Areas of Central Nervous System Research

The most promising area of central nervous system research is thought to be the molecular biology of the brain, with an emphasis on understanding how receptors function in nerve cells, identifying new neurotransmitters, and the biological basis of psychiatric disorders (Table IV-1). Also showing considerable promise are new visualization and imaging techniques, the functional organization of the brain, and better anti-depressant and anti-anxiety drugs.

The Most Fundamental Question in Basic Research on the Central Nervous System

Many researchers believe that the most fundamental research question relates to the functioning of the central nervous system and the brain and the molecular and cellular biology of the central nervous system (Verbatims IV-1).

THE PREVENTION, DIAGNOSIS AND TREATMENT OF CENTRAL NERVOUS SYSTEM DISORDERS

Will Better Prevention, Better Diagnosis, or Better Treatment Do Most to Combat Central Nervous System Disorders in the Year 2000?

Fifty percent of the scientists believe that better treatment will do more than prevention or diagnosis to combat central nervous system disorders (Table IV-2).

THE PREVENTION AND DIAGNOSIS OF CENTRAL NERVOUS SYSTEM DISORDERS

Degree of Improvement Expected in the Prevention of Central Nervous System Disorders by the Year 2000

The most improvement is seen in the prevention of tardive dyskinesia -- a serious side-effect of some anti-psychotic drugs resulting in involuntary repetitious movements of face, limb and trunk muscles (Table IV-3). Fifty-seven percent of the researchers expect moderate to high improvement in the prevention of this condition (Table IV-3). More than one-third of the scientists predict improvement in the prevention of genetic disorders such as Huntington's chorea and strokes. A majority project relatively low levels of improvement for the prevention of Alzheimer's disease, minimal brain dysfunction, traumatic injury to the brain and spinal cord, and brain tumors.

Methods of Preventing and Diagnosing Central Nervous System Disorders: Extent of Use in the Year 2000

Unanimously, central nervous system scientists predict that molecular or immunological probes will be more widely used to detect diseases, like Alzheimer's, at their earliest stages (Table IV-4). Over 90% foresee increased use of genetic markers to screen for known genetic disorders; new visualization and imaging techniques and drugs that will reduce the likelihood of strokes. They also project a more important role for prenatal diagnosis by the year 2000.

THE TREATMENT OF CENTRAL NERVOUS SYSTEM DISORDERS

Degree of Improvement Expected in the Treatment of Central Nervous System Disorders by the Year 2000

Greatest advances are seen for the treatment of depression, with almost two-thirds of CNS researchers projecting moderate to high levels of improvement (Table IV-5). At least half also predict moderate improvement in the treatment of tardive dyskinesia, Parkinsonism and epilepsy.

Alzheimer's Disease, Schizophrenia and Epilepsy: The development of better drugs without side effects will provide the biggest advances in the prevention or treatment of schizophrenia and epilepsy (Verbatims IV-3 and IV-4). Understanding the causes of Alzheimer's disease and schizophrenia are also frequently-mentioned advances (Verbatims IV-2 and IV-3).

The Role of Life Style Changes in Reducing the Incidence and Severity of Central Nervous System Disorders: Reduction in the use and abuse of alcohol and drugs are among the most important life style changes to reduce the incidence and severity of central nervous system disorders (Verbatims IV-5).

Methods of Treating Central Nervous System Disorders: Extent of Use in the Year 2000

Treatments to delay or prevent neuronal loss in degenerative conditions such as Alzheimer's and Parkinsonism will play an important role in the year 2000, according to 87% of the researchers (Table IV-6). Other new therapeutic approaches, such as genetic engineering (87%), nerve growth and regeneration (86%) and brain tissue transplants (76%) also will be used more widely.

Researchers are almost unanimous (96%) in their opinion that psychoanalysis will either be less used or scarcely used at all by the year 2000. About three-quarters of the CNS researchers forecast a decreased use of psychotherapy generally and psychosurgery as well (Table IV-6). Fifty percent of the central nervous system researchers feel that traditional psychoanalytic therapy will be "somewhat unimportant" in the year 2000 (Table IV-9). Thirty-six percent believe that it will be "not important at all."

In interpreting these findings it should be noted that the sample was weighted towards central nervous system scientists engaged in biomedical research. This emphasis on drug therapy may be a function of their bio-medical, rather than clinical psychotherapeutic, orientation.

In contrast, a majority foresee frequent use of two relatively newer forms of psychological treatment: behavioral therapy (57%) and cognitive therapy (54%) (Table IV-6).

The majority of scientists also foresee increased use of drugs for the treatment of disorders of the central nervous system -- anti-depressants (83%), immunosuppressives (80%), anti-psychotics (70%), anti-seizure (60%) and anti-anxiety (57%) (Table IV-6).

Expected New Therapies for Central Nervous System Disorders in the Year 2000: Asked to comment freely on what completely new therapies for central nervous system disorders could be expected by the year 2000, the scientists indicated the development of new drugs for various central nervous system disorders; genetic engineering; and brain tissue transplants (Verbatims IV-6).

The Use of Opiates for Severe Pain in the Year 2000

A majority (69%) predict that opiates will be used less frequently than today to treat severe pain in the year 2000 (Table IV-7).

Drug Therapy vs. Psychotherapy by the Year 2000

As the data in Table IV-8 indicate, the scientists expect the balance in emphasis between drug therapy and psychotherapy to have shifted by the year 2000. Sixty-three percent predict more emphasis on drug therapy and 6% expect an increased emphasis on psychotherapy.

Drug Therapy vs. Electro-Convulsive Therapy by the Year 2000

Seventy-seven percent of the scientists predict greater emphasis on drug therapy and a decline in the use of electroconvulsive therapy in the treatment of depression (Table IV-10). None expect the emphasis on electroconvulsive therapy to increase.

The Use of Fetal Brain Tissue for Human Brain Transplants by the Year 2000: Ethical and Scientific Concerns

A majority of the researchers believe that the use of fetal brain tissue for human brain transplants both will (79%) and should (90%) be acceptable by the year 2000 (Tables IV-11 and IV-12).

Table IV-1

CENTRAL NERVOUS SYSTEM: MOST PROMISING AREAS OF RESEARCH

Base: Central nervous system scientists

Q.: I will read you a short list of some of the major areas of central nervous system research. Please say for each one how promising you think it is on a scale of 0 to 10 where 0 is "not promising at all" and where 10 is "most promising one could imagine".

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 30	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Understanding of receptors and second messengers	16 53%	9 30%	4 13%	1 3%	- -	9
New visualization and imaging techniques	15 50%	9 30%	6 20%	- -	- -	8.5
Identifying new neurotransmitters	13 43%	11 37%	5 17%	1 3%	- -	8
Molecular biology of the brain	10 33%	19 63%	1 3%	- -	- -	8
Biological basis of psychiatric disorders	9 30%	12 40%	7 23%	2 7%	- -	8
Functional organization of the brain	8 27%	14 47%	6 20%	2 7%	- -	8
Better anti-depressant drugs	7 23%	12 40%	5 17%	5 17%	1 3%	8
Better anti-anxiety drugs	5 17%	16 53%	5 17%	3 10%	1 3%	8
Nerve cell growth and regeneration	6 20%	15 50%	6 20%	3 10%	- -	7
Better anti-psychotic drugs	6 20%	9 30%	6 20%	8 27%	1 3%	7
Developing improved etiology and pathogenesis of disorders	5 17%	14 47%	9 30%	2 7%	- -	7

(Continued)

Table IV-1 (Continued)

CENTRAL NERVOUS SYSTEM: MOST PROMISING AREAS OF RESEARCH

Base: Central nervous system scientists

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 30	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Better anti-seizure drugs	5 17%	11 37%	10 33%	3 10%	1 3%	7
Improvements in diagnostic criteria	4 13%	11 37%	11 37%	4 13%	- -	6.5
Genetic therapy for inborn defects like Huntington's chorea	7 23%	7 23%	9 30%	7 23%	- -	6
Function of glial and Schwann cells	3 10%	11 37%	11 37%	5 17%	- -	6

Verbatims IV-1

THE MOST IMPORTANT FUNDAMENTAL QUESTION IN BASIC CENTRAL NERVOUS SYSTEM RESEARCH

Some Representative Quotes

Q.: As you know advances in clinical medicine often result from fundamental advances in basic research. What do you think is the most important fundamental question which needs to be answered in order to achieve a major breakthrough in the treatment of central nervous system disorders?

"Map out the interrelations between different neural systems and how they affect each other. If we understand how neural systems function and how they affect each other we can then determine which systems are deranged in diseased states."

"Better knowledge of the functional organization of the brain. Better understanding of what areas normally control things such as movement and cognition which would then lead to better treatment or prevention of abnormal conditions."

"It will come in the area of cell and molecular biology. We will begin to understand aberrant gene expression in the nervous system. Virtually all major diseases of the nervous system have a molecular biological component; for example, Alzheimer's disease and Huntington's disease. We must characterize these genes. This will be straightforward in diseases like Huntington's and not so easy for diseases like schizophrenia where the genetics is so complex."

"Related to development of the nervous system. Understanding the development of the normal human nervous system will greatly improve our capability to treat it."

"Why brain cells don't replicate themselves. It's so fundamental. Actually I'd say control of synapse formation. I think we'll find that many diseases have to do with an alteration of synaptic mechanisms and we can then make better use of synapses in diseased patients or help them make new synapses."

"We need to pinpoint which proteins or biochemical pathways have gone wrong. In any illness -- an extreme example is schizophrenia -- we have some clues that there is something wrong in the brain that leads to a hyperdopamine level. Either dopamine is overactive or the rest of the brain is underactive. We need to know the pathways underlying that result."

"Right now a critical area is the role of peptide transmitters in both normal and pathological functions. Opioid peptides for example were discovered first because drugs like morphine and naloxone bind to endogenous receptors. Then we found the endogenous substances. Here molecular biology becomes important with the ability to make DNA probes. This could allow us to measure changes in levels of transmitters in pathological states."

(Continued)

Verbatims IV-1 (Continued)

THE MOST IMPORTANT FUNDAMENTAL QUESTION IN BASIC CENTRAL NERVOUS SYSTEM RESEARCH

Some Representative Quotes

"To determine the factors that bring about release of neurotransmitters and factors that affect receptor synthesis in both healthy and diseased states. This would result in better drug treatment. Once you classified diseases into heterogeneous groups, instead of lumping them under one name like Alzheimer's you can get individualization of treatment."

"... what will allow CNS tissue to regenerate. If we can get neurons to recover -- particularly for traumatic injuries -- it could make a big difference in treatment. Big results in regeneration leading to therapeutic treatments won't come in the next 20 years, though."

"The molecular aspects of the virally induced diseases."

Table IV-2

COMBATING CENTRAL NERVOUS SYSTEM DISORDERS IN THE YEAR 2000: BETTER PREVENTION, DIAGNOSIS, OR TREATMENT?

Base: Central nervous system scientists

Q.: Which do you think will do the most to combat central nervous system disorders in the year 2000 -- better prevention, better diagnosis, or better treatment?

	Total
Base	30
Better prevention	10 33%
Better diagnosis	1 3%
Better treatment	15 50%
All equal	2 7%
Not sure	2 7%

Table IV-3

PREVENTING CENTRAL NERVOUS SYSTEM DISORDERS: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Central nervous system scientists

Q.: I will read you a list of conditions. Please say for each one how much of an improvement you think we will make by the year 2000 in the prevention of these conditions? Please use a scale of 0 to 10 where 0 is "no change" and 10 is "will be prevented entirely".

	Expected Degree of Improvement in Prevention					
	Rating Level on a Scale of 0 to 10					
Base: 30	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Tardive dyskinesia	6 20%	11 37%	5 17%	7 23%	1 3%	7
Genetic disorders such as Huntington's chorea	2 7%	9 30%	7 23%	12 40%	- -	6
Strokes and transient ischemic attacks	1 3%	11 37%	10 33%	8 27%	- -	5.5
Parkinsonism	4 13%	7 23%	7 23%	12 40%	- -	5
Depression	1 3%	9 30%	9 30%	11 37%	- -	5
Multiple sclerosis	1 3%	8 27%	11 37%	10 33%	- -	5
Chronic pain	1 3%	7 23%	10 33%	12 40%	- -	5
Anorexia nervosa	1 3%	5 17%	11 37%	13 43%	- -	5
Korsakoff's syndrome	4 13%	4 13%	6 20%	14 47%	2 7%	4.5
Schizophrenia	1 3%	4 13%	10 33%	15 50%	- -	4.5

(Continued)

Table IV-3 (Continued)

PREVENTING CENTRAL NERVOUS SYSTEM DISORDERS: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Central nervous system scientists

	Expected Degree of Improvement in Prevention					
	Rating Level on a Scale of 0 to 10					
Base: 30	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Epilepsy	-	7	8	15	-	4.5
	-	23%	27%	50%	-	
Minimal brain dysfunction	1	5	6	16	2	4
	3%	17%	20%	53%	7%	
Alzheimer's disease	2	4	6	18	-	3.5
	7%	13%	20%	60%	-	
Traumatic injury to the brain and spinal cord	-	4	5	21	-	3
	-	13%	17%	70%	-	
Brain tumors	-	3	5	22	-	3
	-	10%	17%	73%	-	

Table IV-4

WAYS OF PREVENTING AND DIAGNOSING CENTRAL NERVOUS SYSTEM DISORDERS: EXPECTED FREQUENCY OF USE IN THE YEAR 2000

Base: All central nervous system scientists

Q.: I will read a list of current and future ways of preventing or diagnosing disorders of the central nervous system. Would you please say for each one whether in the year 2000 it will be much more widely used than it is today, somewhat more widely used, less widely used, or whether it will scarcely be used at all.

Base: 30	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Molecular or immunologic probes to detect diseases like Alzheimer's at their earliest stages	26 87%	4 13%	- -	- -	- -	- -
Visualization and imaging techniques	24 80%	5 17%	- -	- -	- -	1 3%
Genetic markers to screen for known genetic disorders	23 77%	6 20%	- -	- -	- -	1 3%
Prenatal diagnosis	19 63%	10 33%	- -	- -	- -	1 3%
Genetic markers to screen for susceptibility	19 63%	7 23%	- -	1 3%	1 3%	2 7%
Counseling to prevent alcoholism and drug abuse	10 33%	9 30%	8 27%	3 10%	- -	- -
Immunization against central nervous system infections	9 30%	12 40%	4 13%	2 7%	2 7%	1 3%
Drugs to reduce the likelihood of stroke	6 20%	21 70%	1 3%	2 7%	- -	- -
Nutrition aimed at better brain function	5 17%	15 50%	6 20%	- -	3 10%	1 3%

Table IV-5

TREATING CENTRAL NERVOUS SYSTEM DISORDERS: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Central nervous system scientists

Q.: I will read you a list of conditions. Please say for each one how much of a change we will have made in the treatment of the condition by the year 2000 where 0 is "no change" and 10 is "will have a total and complete cure" by the year 2000.

	Expected Degree of Improvement in Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 30	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Depression	8	11	8	3	-	8
	27%	37%	27%	10%	-	
Tardive dyskinesia	3	13	8	5	1	7
	10%	43%	27%	17%	3%	
Parkinsonism	3	13	7	7	-	7
	10%	43%	23%	23%	-	
Epilepsy	3	12	11	4	-	6.5
	10%	40%	37%	13%	-	
Chronic pain	6	8	11	5	-	6
	20%	27%	37%	17%	-	
Anorexia nervosa	2	10	14	4	-	6
	7%	33%	47%	13%	-	
Schizophrenia	1	9	14	6	-	6
	3%	30%	47%	20%	-	
Brain tumors	2	7	10	11	-	5.5
	7%	23%	33%	37%	-	
Multiple sclerosis	1	9	9	11	-	5
	3%	30%	30%	37%	-	
Genetic disorders such as Huntington's chorea	1	9	6	14	-	5
	3%	30%	20%	47%	-	
Alzheimer's disease	1	8	8	13	-	5
	3%	27%	27%	43%	-	

(Continued)

Table IV-5 (Continued)

TREATING CENTRAL NERVOUS SYSTEM DISORDERS: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Central nervous system scientists

	Expected Degree of Improvement in Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 30	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Strokes and transient ischemic attacks	1	6	11	12	-	5
	3%	20%	37%	40%	-	
Korsakoff's syndrome	-	4	10	14	2	4.5
	-	13%	33%	47%	7%	
Mininal brain dysfunction	-	4	7	17	2	4
	-	13%	23%	57%	7%	
Traumatic injury to the brain and spinal cord	-	3	10	17	-	4
	-	10%	33%	57%	-	

Table IV-6

WAYS OF TREATING CENTRAL NERVOUS SYSTEM DISORDERS: EXPECTED FREQUENCY OF USE IN THE YEAR 2000

Base: Central nervous system scientists

Q.: I will read a list of current and future ways of treating disorders of the central nervous system. Would you please say for each one whether in the year 2000 it will be much more widely used than it is today, somewhat more widely used, less widely used, or whether it will scarcely be used at all.

Base: 30	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Treatments to delay or prevent neuronal loss in degenerative conditions like Alzheimer's and Parkinsonism	15 50%	11 37%	1 3%	- -	1 3%	2 7%
Using genetic engineering to repair genetic defects	14 47%	12 40%	1 3%	- -	2 7%	1 3%
Immunosuppressive drugs	12 40%	12 40%	- -	3 10%	2 7%	1 3%
Nerve growth and regeneration	10 33%	16 53%	1 3%	- -	1 3%	2 7%
Anti-depressant drugs	10 33%	15 50%	3 10%	2 7%	- -	- -
Anti-anxiety drugs	9 30%	8 27%	5 17%	8 27%	- -	- -
Brain tissue transplants	7 23%	16 53%	- -	1 3%	4 13%	2 7%
Anti-psychotic drugs	5 17%	16 53%	5 17%	3 10%	1 3%	- -
Behavioral therapy	5 17%	12 40%	7 23%	5 17%	- -	1 3%
Cognitive therapy	5 17%	11 37%	7 23%	5 17%	- -	2 7%
Anti-seizure drugs	3 10%	15 50%	9 30%	2 7%	- -	1 3%

(Continued)

Table IV-6 (Continued)

WAYS OF TREATING CENTRAL NERVOUS SYSTEM DISORDERS: EXPECTED FREQUENCY OF USE IN THE YEAR 2000

Base: Central nervous system scientists

Base: 30	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Psychosurgery	1	5	1	14	9	-
	3%	17%	3%	47%	30%	-
Psychotherapy	1	4	4	20	1	-
	3%	13%	13%	67%	3%	-
Psychoanalysis	-	-	1	19	10	-
	-	-	3%	63%	33%	-

Verbatims IV-2

BIGGEST ADVANCE IN PREVENTING OR TREATING ALZHEIMER'S DISEASE BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for Alzheimer's disease, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"... determining what it takes to keep a person's brain stimulated. A better understanding of the pathogenesis of the disease. If you could understand how neurotransmitters work and stimulate those pathways you would exercise your brain like you exercise your muscles."

"I hope a better understanding of the genetic causes underlying the disease may help in prevention. As far as treatment, most likely it will be new drug therapies aimed at regeneration of the damaged brain tissues using nerve growth factors."

"There will be a treatment approach at a level more basic than the neurotransmitter level. There will be a treatment that involves a strategy concerned with a more general biological process that is dysfunctional. For example, something like maintaining membrane integrity or preventing cell death as opposed to a higher level treatment as in information transfer -- replacing a neurotransmitter. As more is learned about Alzheimer's we will find that basic processes will be uncovered that are dysfunctional."

"Finding the means to slow or stop the progression of the disease. Drug research will lead to a drug. Chemical or surgical alterations of other pathways could control the disease. Alzheimer's seems to be an imbalance of low acetylcholine levels, low secotonian levels and high norepinephrine levels. It may be possible to restore that balance through drugs or to reduce norepinephrine through surgery."

"I would imagine some drug or nutrient treatment that slows or prevents degenerations. There's no treatment now. When we figure out what causes the disease we'll understand where to go with treatment."

"Prevention. Environmental factors. Places where they have eliminated the water aluminum and other metals. I'm talking about Guam where a high percentage of people were affected by heavy metals in the water supply, which caused many cases of dementia. It was cleared up by cleaning up the water. Maybe diet. Looking at Alzheimer's as a series of mini strokes one would think that a low fat, low cholesterol diet might help."

"The concept of neuromodulation vs. neurotransmission. We're going to understand more about disease when we understand how neuromodulators work -- they're a whole new ballgame -- they work in a completely different time frame from transmitters and that's just not well understood."

Verbatims IV-3

BIGGEST ADVANCE IN PREVENTING OR TREATING SCHIZOPHRENIA BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for schizophrenia, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"I hope we'll be able to subdivide schizophrenia into disorders with common etiologies. Then maybe we can develop better treatments. Currently all the drugs in use treat a set of symptoms and not the disease itself."

"There will be integrated treatments. We'll begin to understand who's vulnerable and what's causing the disease -- whether it's behavioral, environmental or chemical, and we'll treat the disease from all these angles."

"Discovery of the etiology as a virally triggered autoimmune disease. The treatment will involve better prenatal care for pregnant women."

"New drugs without side effects. The hunt is on by the drug companies. Drugs are in clinical trials by many of these companies. It's interesting that in trials it's been shown that Europeans need half as much of these drugs as Americans."

"Realization that the disease has multiple causes, finding specific causes and treating that cause. It's like cancer. For example a subset of schizophrenia is that which is caused probably by a virus and affects males in their 20s. Isolate and treat that subset separately."

"In both schizophrenia and a lot of other diseases with a genetic loading the characterization of the genetic factors -- genes -- plus the characterization of the defects that result from the expression of faulty genes will be important."

"Different types of medications which indirectly affect the dopamine system. Medications which are indirectly antidopaminergic by affecting other transmitter pathways will be developed."

"Understanding the basic biology of the disease. There are no coherent theories of schizophrenia. I'll be very specific and say we know of no consistent biochemical abnormality in the brains of schizophrenics. The new technologies of genetic engineering should allow us to determine the biochemical basis of schizophrenia and get a better handle on the disease."

Verbatims IV-4

BIGGEST ADVANCE IN PREVENTING OR TREATING EPILEPSY BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for epilepsy, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"Epilepsy is a slowly developing area -- there is a real need for a drug that will act on the focus of epileptic seizures and not on the rest of the brain. A big problem is that current drugs act on normal cells making them unreactive to attacks that start at the focus. There should be a way to attack the abnormal cells."

"Drugs which are targeted for a specific region of the brain -- the region patient's epileptic focus -- that do not affect other regions of the brain."

"Development of more effective antiepileptic drugs with fewer side effects. Implicit in that is a better understanding of the pathophysiology. It has so many different causes. It's not going to go away, so we're going to have to provide better care for those who have it."

"There won't be a single breakthrough because epilepsy is not a single condition -- it has multiple causes. For example, an understanding of the neurotransmitters and receptors that are malfunctioning or the brain systems that are of primary importance in the various types of epilepsy."

"Better health care, better obstetrics, fewer brain injuries and better medication to control the approximately 20% of epileptics who are not currently controlled."

"I think problems tend to be approached either from a clinical point of view or as the microscopic problems with the diseased neuron. There will be an understanding of the brain systems involved in seizures. The other approach is understanding the microanatomy of the diseased neurons. What I'm fascinated by is why epileptics don't have seizures all the time. Most of the time they function normally."

"I think surgical treatment for epilepsy is being improved. We'll get better surgical elimination of the loci of seizures in epileptics not treatable with drugs."

"Hereditary forms of epilepsy will be diagnosable, caught easily, and treated early. Better drugs, with less side effects for the non-hereditary (and hereditary) forms."

Verbatims IV-5

LIFE STYLE CHANGES AND CENTRAL NERVOUS SYSTEM DISORDERS

Some Representative Quotes

Q.: What one change in life style would do most to reduce the incidence and severity of central nervous system disorders?

"Less alcohol consumption. It's the one change you could make in the environment that could significantly reduce CNS dysfunction."

"Reduction in alcohol and drug use."

"Avoidance of drug abuse."

"Diet and exercise. Proper attention to diet would reduce hypertension leading to fewer strokes."

"On a global scale, nutrition. In America there's a great deal we don't know about what toxic compounds do to the central nervous system. Ambient exposure levels to these substances, for example organophosphates, are not trivial. Reducing that ... and exercise. Moderating centrally acting toxicants through better diet and minimizing deleterious compounds we ingest, that's my answer. Lead and alcohol and organophosphates are all in there."

"I suppose reducing stress. There is an interaction between stress and some CNS disorders. If you reduce stress you may reduce the incidence of related diseases such as strokes."

"Safety on the roads, less alcohol consumption and less smoking (especially by pregnant women)."

Table IV-7

HOW MUCH WILL OPIATES BE USED TO TREAT SEVERE PAIN IN THE YEAR 2000?

Base: Central nervous system scientists

Q.: In the treatment of severe pain, do you think that normal practice in the year 2000 will be to use more, less, or about the same amount of opiates as are used today?

	Total
Base	28
More	4 14%
Less	20 69%
About the same	4 14%
Not sure	1 3%

Verbatims IV-6

EXPECTED NEW THERAPIES FOR CENTRAL NERVOUS SYSTEM DISORDERS IN THE YEAR 2000

Some Representative Quotes

Q.: By the year 2000 what do you think will be the 2 or 3 most important, completely new types of therapy for central nervous system disorders which are not available now?

"1. New classes of drugs. These advances will be the result of neuromodulator research.
2. Genetic repair. In diseases very easily detected with a marker, genetic repair may become feasible."

"1. Use of various nerve growth factors for neural regeneration.
2. Localized drug delivery systems for manipulating neurochemistry with specificity.
3. Perhaps genetic engineering. If you have a specific group of cells that are prone to degenerative diseases, and you could, early on, use genetic engineering to prevent degeneration, it would be a big advance. This won't happen in the next 20 years, however."

"1. Brain transplants -- actually explants, particularly for Parkinson's disease.
2. Major shift in choice of antipsychotic drugs. Eventually a clozapine-like drug will be accepted on the U.S. market and there will be a major shift in the drugs chosen for treatment of psychoses."

"1. Anything that relates to molecular genetics. New drugs will be developed using the knowledge we gain from molecular genetics.
2. Using imaging techniques to determine structure/function relationships which will lead to new treatments..."

"1. Chemical biofeedback -- finding out how one can influence brain chemistry by behavior. This will be useful for most CNS diseases. Just as chemicals affect behavior, behavior can affect chemistry.
2. There will be a combination of behavioral and cognitive therapies and drug treatments."

"1. Tissue transplants and regeneration.
2. Genetic engineering approaches. In neurodegenerative diseases such as Alzheimer's these treatments will become important."

"1. Neural protheses for sensory or motor losses.
2. Brain transplants.
3. Means of infusing neuromodulators -- osmotic pumps and the like."

Table IV-8

DRUG THERAPY VS. PSYCHOTHERAPY BY THE YEAR 2000

Base: Central nervous system scientists

Q.: By the year 2000, do you think the balance between drug therapy and psychotherapy for central nervous system disorders will have changed? Will there be much more emphasis on one or the other, a little more emphasis, or will the balance be about the same as it is today?

	Total
Base	30
Much more emphasis on drug therapy	13 43%
A little more emphasis on drug therapy	6 20%
Balance same as today	9 30%
A little more emphasis on psychotherapy	1 3%
Much more emphasis on psychotherapy	1 3%
Not sure	- -

Table IV-9

HOW IMPORTANT WILL TRADITIONAL PSYCHOANALYTIC THERAPY BE IN THE YEAR 2000

Base: Central nervous system scientists

Q.: In the year 2000, how important do you think traditional psychoanalytic therapy will be -- very important, somewhat important, somewhat unimportant, or not important at all?

	Total
Base	22
Very important	- -
Somewhat important	3 14%
Somewhat unimportant	11 50%
Not important at all	8 36%
Not sure	- -

Verbatims IV-7

THE ROLE OF TRADITIONAL PSYCHOANALYSIS IN THE YEAR 2000

Some Representative Quotes

Q.: And in the year 2000, what do you think the role of traditional psychoanalytic therapy will be?

"As an intellectual exercise for those who can afford it. It has beneficial effects but it's not really applicable to the major serious causes of mental illness. Some things can be biochemically adjusted."

"To treat personality disorders ... it would be somewhat unimportant."

"There won't be any role for it."

"A means for helping people with creative blocks. Affluent people who feel frustrated and impotent in personal and professional relationships."

"It will remain both an intellectual tool and a way for people to analyze their personalities. It will not be used to treat severe disorders."

Table IV-10

DRUG THERAPY VS. ELECTRO-CONVULSIVE THERAPY BY THE YEAR 2000

Base: Central nervous system scientists

Q.: By the year 2000, do you think the balance between drug therapy and electro-convulsive therapy for depression will have changed? Will there be much more emphasis on one or the other, a little more emphasis, or will the balance be about the same as it is today?

	Total
Base	30
Much more emphasis on drug therapy	18 60%
A little more emphasis on drug therapy	5 17%
Balance same as today	7 23%
A little more emphasis on electroconvulsive therapy	- -
Much more emphasis on electroconvulsive therapy	- -
Not sure	- -

Table IV-11

WILL USE OF FETAL BRAIN TISSUE FOR HUMAN BRAIN TRANSPLANTS BE ACCEPTABLE BY THE YEAR 2000?

Base: Central nervous system scientists

Q.: As you know, some promising animal experiments in brain tissue transplants have used tissue from fetal sources. This raises both ethical and scientific issues. Do you think that by the year 2000 it will or will not be acceptable to use fetal brain tissue for human brain transplants?

	Total
Base	29
Will be acceptable	23 79%
Will not be acceptable	5 17%
Not sure	1 3%

Table IV-12

SHOULD USE OF FETAL BRAIN TISSUE FOR HUMAN BRAIN TRANSPLANTS BE ACCEPTABLE BY THE YEAR 2000?

Base: Central nervous system scientists

Q.: Do you think that the use of fetal brain tissue for human brain transplants should be acceptable?

	Total
Base	29
Should be acceptable	26 90%
Should not be acceptable	2 7%
Not sure	1 3%

Table IV-13

USE OF FETAL BRAIN TISSUE FOR HUMAN BRAIN TRANSPLANTS: EXTENT OF EFFECTIVENESS IN TREATING CENTRAL NERVOUS SYSTEM DISORDERS

Base: Central nervous system scientists

Q.: If it were ethically acceptable to use fetal brain tissue for human brain transplants, do you think it will be very effective for treating a number of CNS conditions, very effective for only a few CNS conditions, or not very effective at all?

	Total
Base	29
Very effective for treating a number of CNS conditions	6 21%
Very effective for treating only a few CNS conditions	14 48%
Not very effective at all	5 17%
Not sure	4 14%

CHAPTER V: INFECTIOUS DISEASES: LOOKING AHEAD TO THE YEAR 2000

RESEARCH ON INFECTIOUS DISEASES: 1986 - 2000

Most Promising Areas of Infectious Diseases Research

Research on genetically engineered vaccines is regarded as the most promising area by 51% of the scientists (Table V-1). Forty-six percent rate diagnostic tests based on monoclonal antibodies as most promising.

The Most Fundamental Question in Basic Research on Infectious Diseases

The most important fundamental research questions are understanding the basic mechanisms of immunity and the basis of pathogenicity of infectious diseases. These two research areas are also cited by some scientists as being among the most promising in Table V-1. Selected excerpts from responses to these open-ended questions are presented in Verbatims V-1 and V-2.

Top Priorities for Infectious Diseases Research: Developing vs. Developed Countries

In Third World countries, malaria is seen as meriting top priority (Verbatims V-3). The highest priority for research in developed countries should be given to AIDS, many scientists believe (Verbatims V-4).

THE PREVENTION, DIAGNOSIS AND TREATMENT OF INFECTIOUS DISEASES: 1986 - 2000

Will Better Prevention, Better Diagnosis, or Better Treatment Do Most to Combat Infectious Diseases in the Year 2000

Fifty-six percent of the scientists believe that better prevention, rather than better treatment, will do the most to combat infectious diseases in the year 2000 (Table V-2).

THE PREVENTION AND DIAGNOSIS OF INFECTIOUS DISEASES

Degree of Improvement Expected in the Prevention of Infectious Diseases by the Year 2000

The greatest improvement in the prevention of infectious diseases is seen for hepatitis (66%), typhoid fever (49%), and haemophilus (51%). By contrast, 59% see no progress for preventing colds (Table V-3). They also are somewhat less optimistic in assessing improved prevention of sexually transmitted diseases such as herpes, AIDS and chlamydia, despite the forecast that there will be a successful vaccine for AIDS within the next 10 years (reported in Table I-11, earlier in this report).

Methods of Preventing and Diagnosing Infectious Diseases: Extent of Use in the Year 2000

A majority of the scientists forecast that genetically engineered vaccines (93%) and diagnostic tests based on monoclonal antibodies (88%) will be used much more widely in the year 2000 (Table V-4). The findings are consistent with the the scientists' expectations that these two areas of research are among the most promising (Table V-1).

THE TREATMENT OF INFECTIOUS DISEASES

Degree of Improvement Expected in the Treatment of Infectious Diseases by the Year 2000

The greatest advances in treatment are predicted, in particular, for cholera, typhoid fever, haemophilus and chlamydia (Table V-5). Infectious disease scientists are less optimistic about AIDS: only 28% project moderate or much improvement in the treatment of AIDS. The majority of specialists feel that little progress will be made in the treatment of colds (53%) and slow viruses (68%).

Malaria, Diarrhea, and the Common Cold: The most frequently predicted important advance in the prevention or treatment of malaria and diarrhea is the development of a new and effective vaccine (Verbatims V-5 and V-6). They also see improved sanitation and better food and water conditions as important advances.

For the common cold, the emphasis shifts from prevention to treatment. A majority of responses predicted the development of therapeutic anti-viral drugs -- drugs to combat the infection once it has started -- as the biggest advance against the common cold (Verbatims V-7).

Methods of Treating Infectious Diseases: Extent of Use in the Year 2000

Ninety-five percent of the researchers expect that antiviral drugs will be in wider use in the year 2000 (Table V-6). Ninety percent indicate greater use of systemic drugs against protozoal diseases. They also project an increased role for drugs that stimulate the immune system (88%), for targeted antibiotics (83%), drugs linked to monoclonal antibodies (88%) and for systemic antifungal drugs (85%). The scientists are almost equally divided on the use of broad-spectrum antibiotics. Thirty-seven project increased usage, 34% a decrease, and 27% forecast they will be used as often as today.

New Therapies for Infectious Diseases in the Year 2000: Elaborating on what new types of therapies could be expected for infectious diseases, the researchers mention -- among many others -- improved anti-viral drugs and immunostimulants or immunomodulators (Verbatims V-8).

Table V-1

INFECTIOUS DISEASES: MOST PROMISING AREAS OF RESEARCH

Base: Infectious diseases scientists

Q.: I will read you a short list of some of the major areas of research into infectious diseases. Please say for each one how promising you think it is on a scale of 0 to 10 where 0 is "not promising at all" and where 10 is "most promising one could imagine".

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 41	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Genetically engineered vaccines	21 51%	14 34%	5 12%	1 2%	- -	9
Tests, probably based on monoclonal antibodies, that can identify pathogens with high specificity	19 46%	17 41%	5 12%	- -	- -	8
Molecular mechanisms by which pathogens evade immune surveillance	10 24%	21 51%	9 22%	1 2%	- -	8
Molecular mechanisms of latency, in viruses like herpes	7 17%	24 59%	3 7%	6 15%	1 2%	8
Immunomodifiers and immunostimulants	10 24%	19 46%	6 15%	6 15%	- -	7
New antiviral drugs	10 24%	17 41%	8 20%	6 15%	- -	7
Drugs that are highly specific against a particular pathogen	7 17%	17 41%	9 22%	8 20%	- -	7
New antibodies	7 17%	16 39%	8 20%	10 24%	- -	7
Treating infections in immunocompromised patients	7 17%	15 37%	12 29%	6 15%	1 2%	7

(Continued)

Table V-1 (Continued)

INFECTIOUS DISEASES: MOST PROMISING AREAS OF RESEARCH

Base: Infectious diseases scientists

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 41	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
New systematic antifungal drugs	5 12%	11 27%	13 32%	11 27%	1 2%	6
Drug-antibody conjugations	4 10%	12 29%	15 37%	8 20%	2 5%	6
New systemic drugs against protozoal parasites	3 7%	17 41%	13 32%	8 20%	- -	6
Genetic markers for proneness to certain infections	2 5%	16 39%	12 29%	11 27%	- -	6
Treating nosocomial (hospital) infections	1 2%	16 39%	18 44%	5 12%	1 2%	6
Passive immunization	3 7%	13 32%	14 34%	10 24%	1 2%	5.5

Verbatims V-1

PROMISING AREAS OF INFECTIOUS DISEASE RESEARCH

Some Representative Quotes

Q.: Is there any other major area of research into infectious diseases which is more promising than those I have mentioned? If so, what is it?

" Molecules which generate broad natural resistance to infections. Molecules with broader specificity than immune modulators. They enhance the activity of cells outside the immune sysytem and thereby increase broad nonspecific resistance."

"Basic immune mechanisms - the understanding at the molecular level."

"Active immunization is [the] major one left off the list. To elicit an active immune response by the host."

"The entire mechanism by which, for example, viruses take over and enter a cell's molecular machinery -- in effect, the information on how the genomes of viruses, once they get into cells, affect those cells. Once understood, this information will give a number of places to block the infection."

Table V-2

COMBATING INFECTIOUS DISEASES IN THE YEAR 2000: BETTER PREVENTION, DIAGNOSIS, OR TREATMENT?

Base: Infectious diseases scientists

Q.: Which do you think will do the most to combat infectious diseases in the year 2000 -- better prevention, better diagnosis, or better treatment?

	Total
Base	41
Better prevention	23 56%
Better diagnosis	6 15%
Better treatment	11 27%
All equal	1 2%
Not sure	- -

Verbatims V-2

THE MOST IMPORTANT FUNDAMENTAL QUESTION IN BASIC RESEARCH ON INFECTIOUS DISEASES

Some Representative Quotes

Q.: As you know, advances in clinical medicine often result from fundamental advances in basic research. What do you think is the most important fundamental question which needs to be answered in order to achieve a major breakthrough in the treatment of infectious diseases?

"Worldwide infectious diseases are, mostly, due to inadequate sanitation and vaccine delivery. Adequate sanitation and vaccination are necessary. This is a sociological question. Fundamental questions in research would be in several areas -- in the general area of immune mechanisms of viral diseases and the process of vaccination. Fundamentally in the regulation of immune response.

"How the immune system works."

"Better understanding of the immune system, molecular mechanisms of pathenogenesis and molecular genetics of micro-organisms as it relates to epidemiology. In essence [how] organisms get around with all relevant molecular mechanisms at both the interaction with host, and genetic information levels. Why certain parasites cycle? Mechanisms of influenza infections. Major mechanisms and explanations of pathenogensis.

"Better understanding of the whole immune response -- how the body fights diseases, why some people get ill and others do not."

"The molecular basis of pathogenesis. How infectious agents cause pathogensis at a molecular level."

"Genetic engineering will lead to a greater understanding of host pathogen interactions -- which is the most important fundamental queston to be answered in order to achieve a major breakthrough. Greater understanding of pathogenesis, transmission and the mechanisms of disease."

"The most fundamental question gets down to the specifics of the host response. Against any infectious agent, the host can respond differently -- be it through interferon or the immune sysytem. If a host cannot help you, then you're really in trouble with that infection. In some cases its NK cells, antibodies, cytotoxic T cells. In specific infections the response will be very specific and we need to understand those responses."

Verbatims V-3

THE TOP PRIORITY FOR INFECTIOUS DISEASES RESEARCH IN THE DEVELOPING COUNTRIES OVER THE NEXT 14 YEARS?

Some Representative Quotes

Q.: What infectious diseases in the developing countries do you think should be the top priority for research over the next 14 years?

"Malaria prevention by vaccines and vector control by biological means. To find ways by which female mosquitos are attracted and to sterilize male mosquitos' insect viruses. That's all."

"Parasitic infections like worms, flukes, sleeping sickness and malaria."

"Malaria and TB -- these are the major causes of death and should have the top priority for research in the developing world."

"Start with the lists of the World Health Organization and the Rockefeller Foundation. Malaria, enteric diarrheal diseases. Yellow fever and dengue."

"Parasitic diseases, a whole range, including malaria, schistosomiasis. Malaria is probably the most important."

"Tuberculosis, malaria, schistosomiasis, diarrhea should all be top priority for the next 14 years. Research to combat antibiotic resistant strains of the infectious disease should be stepped up because the indiscriminate use of antibiotics has generated these frightening pathogens."

"Malaria is probably the single most important disease in the world in both morbidity and mortality. It should be given more attention."

"Probably malaria is the most important one."

Verbatims V-4

THE TOP PRIORITY IN INFECTIOUS DISEASE RESEARCH IN THE UNITED STATES AND THE DEVELOPED WORLD OVER THE NEXT 14 YEARS

Some Representative Quotes

Q.: What infectious disease in the United States and the developed world do you think should be the top priority for research over the next 14 years?

"Undoubtedly AIDS."

"In light of the situation it is AIDS. It is the most dangerous disease that they will have to deal with."

"It's hard to resist the notion that among infectious diseases, the least known or understood threat is AIDS."

"AIDS, the top priority."

"AIDS. All others need attention but AIDS needs top priority."

"AIDS if it continues to progress at the rate it's going. Depending on what happens epidemiologically it should be the top priority. If it's not AIDS, it should be pneumonia - makes the top 10 diseases that kill people, especially the elderly. We need methods to treat and prevent it."

"AIDS -- there is no cure, no treatment, no prevention of the disease and it's growing like wildfire in epidemic proportions."

"Apart from AIDS which is heavily underway more priority should be given to viral infections."

"Mixed feelings. Respiratory infections maybe. But AIDS scares the hell out of me so I'll call it a tie."

Table V-3

PREVENTING INFECTIOUS DISEASES: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Infectious disease scientists

Q.: I will read you a list of conditions. Please say for each one how much of an improvement you think we will make by the year 2000 in the prevention of these conditions. Please use a scale of 0 to 10 where 0 is "no change" and 10 is "will be prevented entirely".

	Expected Degree of Improvement in Prevention					
	Rating Level on a Scale of 0 to 10					
Base: 41	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Hepatitis	11	16	10	4	-	7
	27%	39%	24%	10%	-	
Typhoid fever	8	12	15	4	2	7
	20%	29%	37%	10%	5%	
Haemophilus	2	19	15	4	1	7
	5%	46%	37%	10%	2%	
Cholera	6	10	19	4	2	6
	15%	24%	46%	10%	5%	
Malaria	4	16	15	6	-	6
	10%	39%	37%	15%	-	
Flu	3	15	10	13	-	6
	7%	37%	24%	32%	-	
Herpes	1	13	17	10	-	6
	2%	32%	41%	24%	-	
AIDS	5	11	5	20	-	5
	12%	27%	12%	49%	-	
Dysentery	4	7	20	10	-	5
	10%	17%	49%	24%	-	
Diarrhea	2	7	21	10	1	5
	5%	17%	51%	24%	2%	

(Continued)

Table V-3 (Continued)

PREVENTING INFECTIOUS DISEASES: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Infectious disease scientists

	Expected Degree of Improvement in Prevention					
	Rating Level on a Scale of 0 to 10					
Base: 41	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Chlamydia	1 2%	10 24%	12 29%	16 39%	2 5%	5
Schistosomiasis	- -	8 20%	11 27%	21 51%	1 2%	4
Colds	- -	5 12%	12 29%	24 59%	- -	4
Slow viruses	1 2%	1 2%	12 29%	26 63%	1 2%	3

Table V-4

WAYS OF PREVENTING AND DIAGNOSING INFECTIOUS DISEASES: EXPECTED FREQUENCY OF USE IN THE YEAR 2000

Base: Infectious diseases scientists

Q.: I will read a list of current and future ways of preventing or diagnosing infectious diseases. Would you please say for each one whether in the year 2000 it will be much more widely used than it is today, somewhat more widely used, less widely used, or whether it will scarcely be used at all.

Base: 41	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Genetically engineered vaccines	38 93%	3 7%	- -	- -	- -	- -
Monoclonal antibodies that allow for fast, specific diagnosis	36 88%	5 12%	- -	- -	- -	- -
Genetic markers for proneness to certain infections	22 54%	11 27%	1 2%	3 7%	3 7%	1 2%
Hygiene and sanitary measures	20 49%	13 32%	7 17%	1 2%	- -	- -
Immunization with monoclonal or polyclonal antibodies	15 37%	18 44%	- -	6 15%	1 2%	1 2%
Nutrition	14 34%	18 44%	8 20%	1 2%	- -	- -
Live virus vaccines	12 29%	14 34%	4 10%	10 24%	1 2%	- -
Killed virus vaccines	9 22%	15 37%	5 12%	10 24%	2 5%	- -
Immunization with pooled immunoglobulins from blood donors	5 12%	10 24%	2 5%	16 39%	7 17%	1 2%

Table V-5

TREATING INFECTIOUS DISEASES:
EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Infectious disease scientists

Q.: I will read you a list of conditions. Please say for each one how much of an improvement you think we will make by the year 2000 in the treatment of the condition where 0 is "no change" and 10 is "will have a total and complete cure" by the year 2000.

	Expected Degree of Improvement in Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 40	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Cholera	12 30%	13 33%	3 8%	10 25%	2 5%	7.5
Typhoid fever	13 33%	7 18%	10 25%	7 18%	3 8%	7
Haemophilus	8 20%	17 43%	6 15%	8 20%	1 3%	7
Chlamydia	5 13%	15 38%	12 30%	8 20%	- -	6.5
Dysentery	8 20%	9 23%	14 35%	8 20%	1 3%	6
Herpes	4 10%	14 35%	12 30%	10 25%	- -	6
Diarrhea	3 8%	14 36%	16 41%	6 15%	- -	6
Malaria	5 13%	12 30%	12 30%	11 28%	- -	5
Schistosomiasis	4 10%	8 20%	14 35%	12 30%	2 5%	5
AIDS	4 10%	7 18%	16 40%	13 33%	- -	5

(Continued)

Table V-5 (Continued)

TREATING INFECTIOUS DISEASES:
EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Infectious disease scientists

	Expected Degree of Improvement in Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 40	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Flu	3	9	13	15	-	5
	8%	23%	33%	38%	-	
Hepatitis	3	9	12	16	-	5
	8%	23%	30%	40%	-	
Colds	1	5	13	21	-	4
	3%	13%	33%	53%	-	
Slow viruses	-	1	10	27	2	3.5
	-	3%	25%	68%	5%	

Verbatims V-5

THE BIGGEST ADVANCE IN THE PREVENTION AND TREATMENT OF MALARIA BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for malaria, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"To get to the malaria and to get a treatment vaccine to the population of people who are at high risk."

"Malarial vaccines will have the biggest impact."

"More towards prevention since the treatment will be similar -- the development of a vaccine."

"A specific vaccine in its prevention and treatment. Many approaches pertaining to different life stages of the organism."

"The main thing is prevention. Epidemiology groups will be able to eliminate the carrier. Prevention of the spread of malaria. There is good treatment right now."

"In the prevention of malaria - vaccine development will most certainly be the biggest advance. In its treatment, drugs to deal with chloroquine resistance."

"The prevention will be a possible vaccine and the treatment will be chemotherapy to which the organism will not become resistant."

"Malaria will be better diagnosed and treated, especially in developed countries. Immunizations will be partially successful, especially for travellers from developing countries. In less developing countries such advances will be available only to the affluent few and politically important, because of economic considerations and logistical problems of reaching the affected population."

Verbatims V-6

THE BIGGEST ADVANCE IN THE PREVENTION AND TREATMENT OF DIARRHEA BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for diarrhea, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"It will be vaccines, not treatment. An effective vaccine for the organisms that cause diarrhea, both viral and bacterial."

"Vaccination against enteric bacteria and viruses, active immunization."

"Development of poorly absorbed or non-absorbed antibiotics which prevent colonization in the intestine by disease-causing bacteria."

"Further identification of transmission mechanisms. Understanding pathogenesis and new methods of prevention. Diarrhea in large parts of the world is preventable but lapses are very common. Improvements in diagnosis and surveillance."

"This is mainly a matter of sanitation which will not be solved due to economic realities. On the other hand, better treatments, some vaccines and rehydration will be available. The problem will be to reach those affected and prevent their reinfection."

"Treatments are already in place. Improved sanitation, but that won't work. Improved vaccines for some of the specific agents."

"Diarrhea is mainly viral and bacterial in origin and since the multiplicity of agents is not so large, there is a distinct possibility of developing better wide spectrum vaccines. In terms of therapy: use of interferon."

"General vaccine for a rotavirus."

Verbatims V-7

THE BIGGEST ADVANCE IN THE PREVENTION AND TREATMENT OF THE COMMON COLD BY THE YEAR 2000

Some Representative Quotes

Q.: Specifically for the common cold, what do you think will be the biggest advance in the prevention or treatment by the year 2000?

"In the case of prevention, this is a very tough question because several agents -- mainly viral -- cause colds. A whole battery of vaccines may be feasible but unlikely. Therapy: newer interferons or other anti-viral agents as well as better ways of delivering interferon."

"By medicines that stimulate the immune system to fight off the virus. Nasally administered interferons."

"More alleviation will be available for common cold, but I don't believe in a radical improvement or elimination. The virus's antigenic variation and its enormous permutations will prevent, for quite some time, the development of an efficient vaccine."

"Chemotherapy as both prevention and treatment. We can only prevent the disease through chemotherapy. I am very positive on this point."

"The use of a new species of interferon will take care of the prevention and treatment of common cold."

"[For treatment] antiviral agents that interfere with one or more aspects of the viral lifecycle. It is difficult to immunize against something as mutable as cold virus. It is not productive or wise for healthy people to have high circulating levels of agents that block viral entry. Prevention doesn't look good. Treatment looks better."

"Internasal administration of topical antiviral drugs. There are no good candidates available now. Interferons are associated with bad side effects, such as a bloody nose."

"Most common antigens have been identified in rhinoviruses and these may make for a more universal vaccine."

Table V-6

WAYS OF TREATING INFECTIOUS DISEASES: EXPECTED FREQUENCY OF USE IN THE YEAR 2000

Base: Infectious diseases scientists

Q.: I will read a list of current and future ways of treating infectious diseases. Would you please say for each one whether in the year 2000 it will be much more widely used than it is today, somewhat more widely used, less widely used, or whether it will scarcely be used at all.

Base: 41	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Antiviral drugs	28 68%	11 27%	2 5%	- -	- -	- -
Oral rehydration therapy	21 51%	7 17%	7 17%	2 5%	1 2%	3 7%
Systemic drugs against protozoal diseases	19 46%	18 44%	3 7%	- -	- -	1 2%
Drugs that stimulate the immune system	16 39%	20 49%	- -	2 5%	1 2%	2 5%
Antibiotics that are highly specific for a particular pathogen	15 37%	19 46%	4 10%	2 5%	1 2%	- -
Nutrition	15 37%	16 39%	6 15%	2 5%	- -	2 5%
Drugs linked to monoclonal antibodies	12 29%	24 59%	1 2%	1 2%	2 5%	1 2%
Systemic antifungal drugs	12 29%	23 56%	2 5%	1 2%	- -	3 7%
Broad-spectrum antibiotics	2 5%	13 32%	11 27%	14 34%	1 2%	- -

Verbatims V-8

EXPECTED NEW THERAPIES FOR INFECTIOUS DISEASES IN THE YEAR 2000

Some Representative Quotes

Q : By the year 2000 what do you think will be the 2 or 3 most important , completely new types of therapy for infectious diseases which are not available now?

"Antiviral drugs. New classes of antiviral drugs -- more biological type inhibitors rather than chemically synthesized drugs or chemically synthesized pseudobiological substances that interfere with viral growth or stimulate the host's immune response."

"Agents specifically directed to blocking interactions between parasite and target tissues or organs. New hybrid antibiotics directed to more than one target. 'Warhead' antibiotics generating effective agents after illicit transport. Agents blocking viral attachment to cell surfaces."

"The modification of toxic, pyrogenic situations related to immunoregulation and the action of lymphokines. Therapy directed to the area of host support mechanisms as opposed to the interference with the agent parasite."

"I think there will be agents that block attachment of pathogens to host cells. We will have immunostimulatory agents for certain types of chronic infections, and some sort of systemic antivirals for certain chronic viral infections including AIDS and HTLV III."

"Specifically targeted antivirals, targeted monoclonal antibody-linked drugs, and new immune modulators. Drugs targeted to specific viral functions, for example, for the replicaton of a type of virus and drugs that don't inhibit host DNA replicaton. Also other types of drugs, for example, those which bind to the virus and prevent entry on the virus into the cell. Also monoclonal antibodies as carriers of drugs to specific targets."

"Anti-viral drugs and genetic engineered vaccines against protozoa."

"Genetically engineered vaccines and the use of immunotherapy for tagging a specific antibody and to stimulate the immune response."

CHAPTER VI: NUTRITION IN THE YEAR 2000

RESEARCH ON NUTRITION

Most Promising Areas of Nutritional Research and the Most Fundamental Question in Basic Research on Nutrition

The most promising area of nutritional research will be metabolism and metabolic regulation -- finding out how nutrients are dealt with at the cellular level (Table VI-1).

In nutrition as in the other areas of research, understanding cell mechanism is seen as the fundamental question that needs to be answered (Verbatims VI-I). It is, in fact, seen as the common frontier uniting all areas of biomedical research in the next century.

At the applied research level, nutritional scientists see the most promise in the field of maternal and child nutrition as well as the creation of food products that are higher in nutrients or resistant to drought, micro-organism and insects (Table VI-1).

They see nutritional research making its biggest gains in reducing infant morbidity and mortality -- most specifically in the support of pre-term and very low birth weight infants (Table VI-2).

THE PREVENTIVE ROLE OF NUTRITION

The Role of Nutrition in Preventing Cancer and Heart Disease

Scientists see nutrition as playing an important role in the prevention of cancer and heart disease in the next century:

- o 53% say doctors will still advise patients to eat fiber-containing foods to help prevent cancer (Table VI-3)

- 63% say doctors will advise patients to limit consumption of cholesterol in the interest of preventing heart disease (Table VI-4).

However, researchers do not see substantial improvement in the role of nutrition in preventing these diseases by the year 2000 (Table VI-5).

Many of the nutritional researchers believe that an understanding of the elements in food that promote cancer will be the most important advance in preventing cancer through the use of nutrition (Verbatims VI-2).

Reducing the intake of fats and lowering blood cholesterol levels will be the biggest advances in preventing heart disease (Verbatims VI-3).

Finally, a strong majority (65%) do not believe vitamin supplements will be recommended for the prevention of cancer (Table VI-6).

Table VI-1

NUTRITION: MOST PROMISING AREAS OF RESEARCH

Base: Nutrition scientists

Q.: I will read you a short list of some of the major areas of nutritional research. Please say for each one how promising you think it is on a scale of 0 to 10 where 0 is "not promising at all" and where 10 is "most promising one could imagine".

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 51	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Maternal and child nutrition	13	22	9	5	2	8
	25%	43%	18%	10%	4%	
Metabolism and metabolic regulation	13	20	16	1	1	8
	25%	39%	31%	2%	2%	
Direct genetic therapy for inborn metabolic defects	17	9	13	10	2	7
	33%	18%	25%	20%	4%	
Nutrition and the immune system	13	16	10	11	1	7
	25%	31%	20%	22%	2%	
Creation of food products that are higher in nutrients or resistant to drought, micro-organism, and insects	12	22	10	5	2	7
	24%	43%	20%	10%	4%	
Health effects of changing diet in developing nations	13	11	12	13	2	6
	25%	22%	24%	25%	4%	
Total parenteral nutrition	10	14	14	12	1	6
	20%	27%	27%	24%	2%	
Development of drugs that alter cholesterol metabolism	7	17	14	12	1	6
	14%	33%	27%	24%	2%	
Determining human micronutrient requirements	6	16	12	16	1	6
	12%	31%	24%	31%	2%	
Identifying and treating marginal vitamin deficiencies	8	4	12	23	4	5
	16%	8%	24%	45%	8%	
Artificial digestible lipids as substitutes for ordinary fats in the diet	6	7	11	25	2	4
	12%	14%	22%	49%	4%	
Isolating and characterizing new vitamins	2	3	8	36	2	2
	4%	6%	16%	71%	4%	

Verbatims VI-1

THE MOST IMPORTANT FUNDAMENTAL QUESTION IN BASIC NUTRITIONAL RESEARCH

Some Representative Quotes

Q : As you know, advances in clinical medicine often result from fundamental advances in basic research. What do you think is the most important fundamental question which needs to be answered in order to achieve a major breakthrough in nutritional research?

"The factors which control and moderate cell growth, cell differentiation and regeneration; also tissue and organ formation, their function and interrelationship. These basic questions are not questions of nutrition per se, yet understanding these fundamental relationships will allow the application of nutritive knowledge to affect them."

"Determination of nutrient requirements at the cellular level."

"The role of nutrient effects on gene expression and regulation. I want to see the effects, for example, on replication of DNA."

"Ability for investigators to measure energy expenditure in freeliving conditions, not in specialized units. Determining the caloric needs of a variety of people and patients of different populations, different professions and different age groups."

"How does early life nutrition influence an individual's long-term resistance to degenerative and chronic diseases."

"Better understanding of metabolic processes and individual differences in metabolic processes, i.e. different ways of handling different nutrients and differing capacities for dealing with these."

"The mechanism of action of vitamins and minerals."

Table VI-2

PREVENTIVE AND THERAPEUTIC ROLE OF NUTRITION: EXPECTED DEGREE OF USE BY THE YEAR 2000

Base: Nutrition scientists

Q: By the year 2000, how much of an increase do you foresee in the use of nutrition in the following -- a great deal, quite a lot, not much, or none at all?

Base: 51	A Great Deal	Quite a Lot	Not Much	None at All	Not Sure
Support of preterm and very low birth weight infants	27 53%	20 39%	2 4%	- -	2 4%
Reduced infant morbidity and mortality	23 45%	13 25%	12 24%	2 4%	1 2%
Extending life expectancy	13 25%	19 37%	17 33%	1 2%	1 2%
Preventing infectious diseases in infancy	9 18%	25 49%	14 27%	2 4%	1 2%
Enhancing the body's immune function	8 16%	24 47%	16 31%	1 2%	2 4%
Preventing infectious diseases in the elderly	2 4%	20 39%	28 55%	- -	1 2%

Table VI-3

FIBER-CONTAINING FOODS: THEIR ROLE IN PREVENTING CANCER IN THE YEAR 2000

Base: Nutrition scientists

Q.: Do you expect that in the year 2000 doctors will be advising their patients to eat fiber-containing foods to help prevent cancer, or not?

	Total
Base	51
Expect	27 53%
Do not expect	17 33%
Not sure	7 14%

Table VI-4

CHOLESTEROL CONSUMPTION: ITS ROLE IN PREVENTING HEART DISEASE IN THE YEAR 2000

Base: Nutrition scientists

Q.: Do you expect that in the year 2000 doctors will be advising their patients to limit their consumption of cholesterol as a way to prevent heart disease, or not?

	Total
Base	51
Expect	32 63%
Do not expect	16 31%
Not sure	3 6%

Table VI-5

THE PREVENTIVE ROLE OF NUTRITION: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Nutrition scientists

Q.: I will read you a list of conditions. Please say for each one how much improvement you think we will make by the year 2000 in the prevention of the condition through the use of nutrition? Please use a scale of 0 to 10 where 0 is "no change" and 10 is "will be prevented entirely".

	Expected Degree of Improvement in Prevention Through Nutrition					
	Rating Level on a Scale of 0 to 10					
Base: 51	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Obesity	9	8	18	14	2	5
	18%	16%	35%	27%	4%	
Cardiovascular disease	4	16	17	12	2	5
	8%	31%	33%	24%	4%	
Hypertension	3	12	14	20	2	5
	6%	24%	27%	39%	4%	
Osteoporosis	2	13	18	16	2	5
	4%	25%	35%	31%	4%	
Diabetes	2	12	20	15	2	5
	4%	24%	39%	29%	4%	
Cancer	1	6	18	23	3	5
	2%	12%	35%	45%	6%	
Alcoholism	3	4	7	33	4	3
	6%	8%	14%	65%	8%	
Psychiatric disorders such as overeating with induced vomiting	2	6	8	30	5	3
	4%	12%	16%	59%	10%	
Chronic liver disease	1	5	12	28	5	3
	2%	10%	24%	55%	10%	
Pancreatitis	-	7	7	34	3	3
	-	14%	14%	67%	6%	

(Continued)

Table VI-5 (Continued)

THE PREVENTIVE ROLE OF NUTRITION: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

	Expected Degree of Improvement in Prevention Through Nutrition					
	Rating Level on a Scale of 0 to 10					
Base: 51	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Chronic renal disease	-	4	8	36	3	3
	-	8%	16%	71%	6%	
Chronic gastrointestinal disease such as ulcerative colitis, cystic fibrosis, and Crohn's disease	-	3	9	36	3	3
	-	6%	18%	71%	6%	
Arthritis	-	3	10	35	3	2.5
	-	6%	20%	69%	6%	
Genetic disorders of metabolism	1	6	2	17	-	2
	4%	23%	8%	65%	-	
Chronic lung disease	-	3	8	36	4	2
	-	6%	16%	71%	8%	
Alzheimer's disease	-	2	5	41	3	2
	-	4%	10%	80%	6%	
Other dementias	-	1	4	43	3	2
	-	2%	8%	84%	6%	

Verbatims VI-2

BIGGEST NUTRITIONAL ADVANCE IN PREVENTING OR TREATING CANCER IN THE YEAR 2000

Some Representative Quotes

Q.: Specifically for cancer, what do you think will be the biggest nutritional advance in prevention or treatment by the year 2000?

"Identifying food substances that trigger the oncogene. (We are) now beginning to see an association with nitrates and nitrosamines, bile acids and free radicals and we will be getting more knowledge of the treatment of these diseases."

"Better definition of what in the diet is carcinogenic. Also what in the diet may help prevent cancer ... the diet has a twofold effect, prevention and treatment."

"Either that some cancers are aided substantially by lowering dietary fat or that there are some micronutrients whose metabolism is more important in the prevention of cancer than ones we emphasize now, i.e., folate vs. Vitamins A and C."

"Understanding how foodstuffs ingested over a lifetime, like isomeric fatty acids, affect membrane structure and immune function thereby making cancer more likely."

"Completion of all new prospective interventional trials involving such substances as selenium, carotinoids, Vitamin A, Vitamin C, decreased fat intake, etc. It is just getting under way and it will take 15 years to reach reasonable conclusions."

"The use of folic acid, carotene and Vitamin B12 to prevent chromosome damage (particulary in susceptible individuals with identifiable fragile sites on chromosomes) and the use of Vitamins C and E to prevent oxidant damage to lipid membranes. Certain nutrients and derivatives (e.g. retinoids) may prove useful for treatment or suppression of the promotion phase."

Verbatims VI-3

BIGGEST NUTRITIONAL ADVANCE IN PREVENTING OR TREATING HEART DISEASE IN THE YEAR 2000

Some Representative Quotes

Q.: Specifically for heart disease, what do you think will be the biggest nutritional advance in prevention or treatment by the year 2000?

"Ascertaining the final answer on fat content of the diet and unraveling the current hypothesis concerning hypertensive disease as it relates to factors such as sodium chloride, potassium, calcium. By (the year) 2000 we ought to be able to put those into (the) proper perspective."

"More detailed understanding of the relationship to cardiovascular disease of dietary intake of cholesterol and of the quality and quantity of dietary fat."

"The recognition that a low-fat diet, perhaps specific fatty acid compositions, will be helpful."

"Reduction of coronary heart disease by dietary management. If (the) population at large can be educated to reduce cholesterol and fat intake, we can significantly impact the incidence of coronary heart disease."

"The realization that too many calories, regardless of source, leading to overweight and then obesity is a major hazard in heart disease; also the incorporation of the omega 3 fatty acids (from certain fish oils)."

"Better understanding of the molecular role of lipids and of the role of various types of lipids in heart disease."

"Use of resins to bind bile acids and widespread use of diets with monounsaturated fatty acids. Possibly the introduction of non-caloric fat analogs."

"Prevention of heart disease with micronutrient deficiency prevention, i.e., selenium. Treatment of heart disease through nutritional implementation of dietary guidelines. Dietary modification."

Table VI-6

VITAMINS: THEIR ROLE IN PREVENTING CANCER IN THE YEAR 2000

Base: Nutrition scientists

Q.: In the year 2000, do you expect that doctors will be advising their patients to take vitamin supplements to help prevent cancer, or not?

	Total
Base	51
Expect	12 24%
Do not expect	33 65%
Not sure	6 12%

Table VI-7

IMPROVING PEOPLE'S HEALTH THROUGH NUTRITION: APPLYING WHAT WE KNOW VS. DOING NEW RESEARCH

Base: Nutrition scientists

Q.: In your opinion, which would do more to improve people's health: teaching people to apply what we already know about nutrition, or doing research to gain new knowledge?

	Total
Base	51
Teach	18 35%
Research	17 33%
Equal importance	11 22%
Not sure	5 10%

Table VI-8

THE THERAPEUTIC ROLE OF NUTRITION:
EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Nutrition scientists

Q.: I will read you a list of conditions. Please say for each one how much of a change you think we will have made in the treatment of this condition through the use of nutrition where 0 is "no change" and 10 is "will have a total and complete cure by the year 2000".

	Expected Degree of Improvement in Treatment Through Nutrition					
	Rating Level on a Scale of 0 to 10					
Base: 49	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Obesity	6	17	12	14	-	6
	12%	35%	24%	29%	-	
Diabetes	3	20	12	14	-	6
	6%	41%	24%	29%	-	
Hypertension	4	11	17	17	-	5
	8%	22%	35%	35%	-	
Chronic renal disease	3	10	14	21	-	5
	6%	21%	29%	44%	-	
Osteoporosis	1	15	14	19	-	5
	2%	31%	29%	39%	-	
Cardiovascular disease	1	12	20	16	-	5
	2%	24%	41%	33%	-	
Genetic disorders of metabolism	1	5	11	10	-	5
	4%	19%	41%	37%	-	
Alcoholism	3	6	7	33	-	4
	6%	12%	14%	67%	-	
Chronic gastrointestinal disease such as ulcerative colitis, cystic fibrosis, and Crohn's disease	2	7	11	28	-	4
	4%	15%	23%	58%	-	

(Continued)

Table VI-8 (Continued)

THE THERAPEUTIC ROLE OF NUTRITION: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Nutrition scientists

	Expected Degree of Improvement in Treatment Through Nutrition					
	Rating Level on a Scale of 0 to 10					
Base: 49	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Chronic liver disease	-	8	14	25	-	4
	-	17%	30%	53%	-	
Psychiatric disorders such as overeating with induced vomiting	3	6	7	31	-	3
	6%	13%	15%	66%	-	
Pancreatitis	1	8	9	31	-	3
	2%	16%	18%	63%	-	
Cancer	1	5	10	32	-	3
	2%	10%	21%	67%	-	
Arthritis	-	3	7	38	-	2
	-	6%	15%	79%	-	
Chronic lung disease	-	1	9	38	-	2
	-	2%	19%	79%	-	
Alzheimer's disease	-	1	3	45	-	2
	-	2%	6%	92%	-	
Other dementias	-	1	2	45	-	2
	-	2%	4%	94%	-	

Verbatims VI-4

BIGGEST NUTRITIONAL ADVANCE IN PREVENTING OR TREATING OBESITY IN THE YEAR 2000

Some Representative Quotes

Q.: Specifically for obesity, what do you think will be the biggest nutritional advance in prevention or treatment by the year 2000?

"Moderation in diet and greater emphasis on physical activity."

"There must be an effort to raise the energy expenditure in our sedentary society. We have to have awareness of total diet rather than isolated elements. Fats and carbohydrates are each a part, but how do they interact to form a diet that contributes to obesity?"

"I don't think the role of obesity lies in overeating. It is primarily lack of physical activity. But, to the degree that low calorie foods are available, this will improve the quality of life. When light beer came on the market, people drank two beers instead of one."

"This is one public health problem that will not be solved with low calorie sweeteners or different types of carbohydrate polymers, but by the change in life style and greater intake of vegetables, fruits and polyunsaturated fatty acids."

"Safe methods of controlling fat storage to allow the fat to be burned off as heat (i.e., the thyroid effect). Alternately safe regulators of fat metabolism to interfere with the laying down of fat."

"The understanding of how the metabolic "set-point" for energy balance is established in different individuals and whether this can be manipulated with drugs."

"I think it will be understanding energy metabolism and the regulation of energy storage so that we can make specific dietary or drug interventions in people at risk."

CHAPTER VII: BIOTECHNOLOGY IN THE YEAR 2000

RESEARCH ON BIOTECHNOLOGY

The most promising area in biotechnology research will be increased understanding of how genes work (Table VII-1).

In applied use, the development of genetically engineered vaccines is seen as the most promising area of research (Table VII-1).

Genetically engineered vaccines will have the highest impact on medical treatment according to 85% of the scientists (Table VII-3).

THE PREVENTIVE AND THERAPEUTIC ROLE OF BIOTECHNOLOGY

Biotechnology researchers (72%) see much or some improvement in the prevention or treatment of AIDS through products of biotechnology by the year 2000. The greatest improvement, however, is seen in the prevention or treatment of hepatitis (81%) and malaria (77%) (Table VII-4).

To a lesser extent, 58% also see some improvement resulting from products of biotechnology in the treatment or prevention of leukemias and lymphomas (Table VII-4).

[However when all 227 scientists were asked to select the disease in which genetic engineering will have the greatest impact, more of them (26%) singled out cancer than any other disease (Table I-5).]

BIGGEST BIO-ENGINEERING ADVANCE FOR ORGAN TRANSPLANTS, CANCER AND HEART DISEASE

The prevailing sentiment among researchers is that the biggest bio-engineering advance in organ transplants will be increased understanding of the immune system. This would be accomplished by developing drugs that would combat the body's normal rejection system (Verbatims VII-1).

For cancer, understanding the molecular etiology of cell growth and oncogenes would constitute the biggest advance from bio-engineering (Verbatims VII-2).

There is also a general belief among researchers that the biggest bio-engineering advance for heart disease will come about with a better understanding of the molecular reasons for deposits of lipids and cholesterol on the walls of blood vessels (Verbatims VII-3).

EXTENT OF APPROVAL FOR ALTERING THE GERM LINE

Scientists are almost equally divided on the issue of direct genetic therapy for a serious inherited defect if such therapy would involve altering the germ line of treated individuals (Table VII-5).

THE RISKS OF GENETIC ENGINEERING AND THE REGULATION OF BIOTECHNOLOGY

For the most part, biotechnology scientists are satisfied with government regulations assessing the risks and benefits of genetic engineering (Table VII-6). Eighty-six percent of them feel that the risks of genetic engineering have been greatly exaggerated (Table VII-7). Sixty-two percent also believe it is important to preserve natural genetic diversity through plant and animal gene banks (Table VII-8).

Table VII-1

BIOTECHNOLOGY: MOST PROMISING AREAS OF RESEARCH

Base: Biotechnology scientists

Q.: I will read you a short list of some of the major areas of biotechnology. Please say for each one how promising you think it is on a scale of 0 to 10 where 0 is "not promising at all" and where 10 is "most promising one could imagine".

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 21	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Molecular mechanisms of gene expression and regulation	15	5	1	-	-	10
	71%	24%	5%	-	-	
Molecular mechanisms of transcription and translation	13	7	1	-	-	9
	62%	33%	5%	-	-	
Genetically engineered vaccines	13	5	-	1	2	9
	62%	24%	-	5%	10%	
DNA probes	12	4	4	-	1	9
	57%	19%	19%	-	5%	
Producing proteins for therapeutic use, such as lymphokines	10	8	-	1	2	9
	48%	38%	-	5%	10%	
Monoclonal antibodies for diagnostic tests	9	5	4	2	1	8
	43%	24%	19%	10%	5%	
Methods to insert new DNA at specific locations in the genome	8	8	2	3	-	8
	38%	38%	10%	14%	-	
Molecular mechanisms of cell growth and differentiation	6	11	3	-	1	8
	29%	52%	14%	-	5%	
Improving methods for recovery and purification of biotechnical products from culture vats	6	6	3	3	3	7.5
	29%	29%	14%	14%	14%	
Transposons	7	5	7	1	1	7
	33%	24%	33%	5%	5%	

(Continued)

Table VII-1 (Continued)

BIOTECHNOLOGY: MOST PROMISING AREAS OF RESEARCH

Base: Biotechnology scientists

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 21	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Human monoclonal antibodies	5 24%	5 24%	7 33%	1 5%	3 14%	7
Improving methods for large-scale culture of bacterial, plant, and animal cells	4 19%	7 33%	4 19%	4 19%	2 10%	7
Improving the binding strength (or binding constant) of monoclonal antibodies	2 10%	8 38%	6 29%	3 14%	2 10%	7
Monoclonal antibodies for therapy, including using antibodies to carry a drug or toxin to specific sites	- -	13 62%	5 24%	2 10%	1 5%	7
Complete genetic sequence of the human genome	7 33%	2 10%	3 14%	8 38%	1 5%	6
Function of introns	3 14%	5 24%	8 38%	5 24%	- -	6
Methods to control the immunoglobulin type of monoclonal antibodies	2 10%	7 33%	9 43%	1 5%	2 10%	6
Development of better microbes as host cells for culturing products	2 10%	3 14%	10 48%	4 19%	2 10%	6
New manufacturing methods for conventional drugs, such as antibiotics	1 5%	5 24%	8 38%	4 19%	3 14%	5.5
Altering prokaryotic cells so they will perform functions such as glycosylation that are now limited to eukaryotic cells	- -	3 14%	6 29%	10 48%	2 10%	4

Table VII-2

PRODUCTION OF DRUGS BY THE YEAR 2000: CONVENTIONAL MEANS VS. GENETICALLY ALTERED MICROBES

Base: Biotechnology scientists

Q.: One estimate is that 20 percent of the drugs that are today produced by conventional means will, by the turn of the century, be produced by genetically altered microbes or cells. In your view, is that estimate too high, too low, or about right?

	Total
Base	21
Too high	10 48%
Too low	2 10%
About right	6 29%
Not sure	3 14%

Table VII-3

MEDICALLY RELEVANT GENETIC ENGINEERING PRODUCTS: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Biotechnology scientists

Q.: I will read you a list of a few of the medically relevant products that have been produced or soon will be produced through genetic engineering. Please say for each one how much of an impact it will have on treatment by the year 2000, using a scale of 0 to 10 where 0 means "it will have made no impact" and 10 means "it will have revolutionized the treatment of the relevant condition."

	Expected Degree of Impact on Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 21	Much Change (9-10)	Moderate Change (7-8)	Slight Change (5-6)	No Change (0-4)	Don't Know/ No Answer	Median
Genetically engineered vaccines	11 52%	7 33%	1 5%	1 5%	1 5%	9
Tissue plasminogen activator	5 24%	8 38%	6 29%	- -	2 10%	8
Clotting factor VIII	4 19%	10 48%	3 14%	1 5%	3 14%	8
Interleukins	1 5%	8 38%	11 52%	- -	1 5%	6
Human growth hormone	3 14%	5 24%	5 24%	7 33%	1 5%	5.5
Kidney plasminogen activator	1 5%	4 19%	3 14%	4 19%	9 43%	5.5
Epidermal growth factor	1 5%	4 19%	6 29%	9 43%	1 5%	5
Alpha, beta, and gamma interferons	- -	4 19%	10 48%	6 29%	1 5%	5
Tumor necrosis factor	- -	2 10%	11 52%	6 29%	2 10%	5
Nerve growth factor	2 10%	3 14%	5 24%	10 48%	1 5%	4.5
Human insulin	- -	2 10%	7 33%	11 52%	1 5%	3.5
Serum albumin	- -	3 14%	1 5%	15 71%	2 10%	3

Table VII-4

THE PREVENTIVE AND THERAPEUTIC ROLE OF BIOTECHNOLOGY: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Biotechnology scientists

Q.: I will read you a list of conditions. Please say for each one how much improvement in the prevention or treatment of each one you think will result from the products of biotechnology by the year 2000 using a scale of 0 to 10 where 0 is "no change" and 10 is "will be prevented entirely".

	Expected Degree of Improvement in Prevention and Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 21	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Hepatitis	7 33%	10 48%	3 14%	- -	1 5%	8
Malaria	6 29%	10 48%	4 19%	1 5%	- -	8
Cholera	6 29%	8 38%	5 24%	2 10%	- -	8
Hemophilia	5 24%	9 43%	5 24%	1 5%	1 5%	8
AIDS	2 10%	13 62%	3 14%	3 14%	- -	8
Diabetes	4 19%	8 38%	6 29%	2 10%	1 5%	7.5
Leukemias and lymphomas	2 10%	10 48%	6 29%	3 14%	- -	7
Diarrheal illness	4 20%	5 25%	7 35%	2 10%	2 10%	6.5
Herpes	1 5%	9 43%	11 52%	- -	- -	6
Thalassemia	3 14%	2 10%	7 33%	8 38%	1 5%	5

(Continued)

Table VII-4 (Continued)

THE PREVENTIVE AND THERAPEUTIC ROLE OF BIOTECHNOLOGY: EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Biotechnology scientists

	Expected Degree of Improvement in Prevention and Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 21	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Sickle-cell anemia	2	-	9	9	1	5
	10%	-	43%	43%	5%	
Cardiovascular and cerebrovascular disease	-	4	8	7	2	5
	-	19%	38%	33%	10%	
Arthritis	-	3	10	6	1	5
	-	15%	50%	30%	5%	
Multiple sclerosis	-	3	9	6	3	5
	-	14%	43%	29%	14%	
Solid tumors	-	2	12	7	-	5
	-	10%	57%	33%	-	
Huntington's chorea	1	4	4	11	1	4
	5%	19%	19%	52%	5%	
Muscular dystrophy	-	4	5	11	1	4
	-	19%	24%	52%	5%	
Slow viruses	-	2	7	11	1	4
	-	10%	33%	52%	5%	
Parkinsonism	-	2	2	14	3	4
	-	10%	10%	67%	14%	
Chronic pain	-	4	2	12	3	3
	-	19%	10%	57%	14%	
Alzheimer's disease	-	1	4	15	1	3
	-	5%	19%	71%	5%	

(Continued)

Table VII-4 (Continued)

THE PREVENTIVE AND THERAPEUTIC ROLE OF BIOTECHNOLOGY:
EXPECTED DEGREE OF IMPROVEMENT BY THE YEAR 2000

Base: Biotechnology scientists

	Expected Degree of Improvement in Prevention and Treatment					
	Rating Level on a Scale of 0 to 10					
Base: 21	Much Improvement (9-10)	Some Improvement (7-8)	Slight Improvement (5-6)	No Improvement (0-4)	Don't Know/ No Answer	Median
Brain and central nervous system disorders	-	1	2	16	2	3
	-	5%	10%	76%	10%	
Down's syndrome	1	2	4	14	-	2
	5%	10%	14%	67%	10%	
Psychiatric disorders	-	2	3	14	2	2
	-	10%	19%	67%	-	
Epilepsy	-	1	4	15	1	2
	-	5%	19%	71%	5%	

Verbatims VII-1

BIGGEST BIO-ENGINEERING ADVANCE FOR ORGAN TRANSPLANTS

Some Representative Quotes

Q.: Specifically for organ transplants, what do you think will be the biggest advance resulting from bio-engineering by the year 2000?

"I would say prevention of rejection...an increased understanding of the immune system. This would be accomplished by developing drugs that would combat the body's normal rejection system."

"The ability to shut down the immune response. This is a method for controlling rejection. Lymphokine type molecules that would suppress the immune system so that the immune system would not respond to the transplant. These suppressible lymphokines would be natural suppressive molecules of the type that must be present during pregnancy so that mother does not reject fetus."

"I presume the main advance would be knowledge of how to control the immune system. This would be by identifying the genes involved in recognition of self and non-self. The basic biology of the immune system really needs work. Our knowledge is so primitive we have very little idea of tolerance. That involves basic research, identifying the genes, cloning them, and studying how they work."

"Most likely through manipulation of the complex immune response. By selectively suppressing the lymphocytes that recognize the transplanted tissue as foreign and therefore, destroy it. Subsequently, adapting the host to modify its lymphocytes so it will see the transplanted tissue as self'."

"Controlling rejection, reducing the need for MHC [major histocompatibility complex] matching."

"I think that the most important potential advance will be to understand the process of regeneration. This will be more important than transplantation. It will make it obsolete. This is a major biological goal that is only being pressed at low levels."

Verbatims VII-2

BIGGEST BIO-ENGINEERING ADVANCE FOR CANCER

Some Representative Quotes

Q.: Specifically for cancer, what do you think will be the biggest advance resulting from bio-engineering by the year 2000?

"Molecular etiology. The genes and gene products involved in the development of cancer, growth control, differentiation control -- these will be understood in the next fifteen years. The tools used will be biotechnological."

"Understanding the control of cellular growth processes and the role of cellular interactions including mechanisms of cellular invasion of surrounding tissue. The cancer cells must communicate with their surroundings, giving and receiving signals that could be inductive, suppressive, etc."

"Identification of some specific gene abnormalities that are cancer causing."

"The implication of oncogenes in cancer, identification of gene abnormalities and possibly a therapy to cope with it once you understand what the gene product is."

"If you interpret bioengineering as molecular biology, you will understand growth much better. Cancer will be split up into different types and there will be an appreciation of how to attack each one."

"Stimulating immune surveillance so that the body will identify cancer cells."

"One of the biggest advances has already occurred: identifying that mutations in specific genes that cause cancer. Between now and the year 2000 in terms of treatment, I think epidemiology is important. What are the events in the environment that cause these mutations to occur?"

"Bioengineering in its basic research context. In terms of development of clinical therapies, it wouldn't be fruitful. In terms of the molecular biology, the biggest advance will be understanding growth control; understanding the metabolism of which oncogenes are apart."

"Characterization of growth factors and their receptors."

Verbatims VII-3

BIGGEST BIO-ENGINEERING ADVANCE FOR HEART DISEASE

Some Representative Quotes

Q.: Specifically for heart disease, what do you think will be the biggest advance resulting from bio-engineering by the year 2000?

"I think it will have to do with atherosclerosis...either controlling cholesterol metabolism in those individuals who tend to hyperchloremia or something that would interfere with the initial pathology at the endothelial cell level. Interfering with the response to pathological lipoprotein metabolism."

"It should be possible to reverse atherosclerosis, specifically plaque formation -- actually reverse it, not just halt further accumulation. It may be by enzymes or other compounds that dissolve the plaques. I think that the year 2000 might be pushing it."

"People will have an appreciation of the effects of cholesterol, the effects of different defects associated with it, with respect to diet and genetic predisposition. All of these will give us a better handle as opposed to one big advance."

"Control of blood lipids. Through drugs that control the metabolism of blood lipids and excretion -- how they are handled within the body. The regulation of cholesterol via uptake through the gut -- processing through cells, right down to excretion."

"A better understanding of the molecular reasons for deposition of lipid and cholesterol on the walls of blood vessels."

"Bioengineering might allow the understanding of heart hormones. The cause of heart disease is linked to high blood pressure and this is linked to the development of heart disease."

Table VII-5

ALTERING THE GERM LINE OF INDIVIDUALS WITH SERIOUS INHERITED DEFECTS: EXTENT OF APPROVAL

Base: Biotechnology scientists

Q.: Would you approve of direct genetic therapy for a serious inherited defect if such therapy would necessarily involve altering the germ line of treated individuals?

	Total
Base	21
Would approve	9 43%
Would not approve	10 48%
Not sure	- -
Refused	2 10%

Table VII-6

SATISFACTION WITH NEW U.S. GOVERNMENT RULES FOR GENETIC ENGINEERING RESEARCH AND PRODUCTS

Base: Biotechnology scientists

Q.: The United States federal government has recently announced new rules for assessing the risks and benefits of new genetic engineering research and new products. From what you have read, are you very satisfied, somewhat satisfied, somewhat dissatisfied, or very dissatisfied with these new rules?

	Total
Base	21
Very satisfied	1 5%
Somewhat satisfied	12 57%
Somewhat dissatisfied	6 29%
Very dissatisfied	- -
Don't know enough about them	2 10%
Not sure	- -

Table VII-7

WHERE DO SCIENTISTS STAND ON THE CONTROVERSY OVER RISKS OF GENETIC ENGINEERING?

Base: Biotechnology scientists

Q.: Do you agree or disagree with the following statements?

Base: 21	Agree	Disagree	Not Sure
The risks of genetic engineering have been greatly exaggerated	18 86%	3 14%	- -
The controversy over safety has helped the biotechnology industry by encouraging the creating of rational guidelines under which the industry can move ahead	13 62%	6 29%	2 10%
The unjustified fears of genetic engineering have seriously impeded the development of valuable new drugs and therapies	2 10%	19 90%	- -
The potential danger from genetically altered cells and microbes is so great that strict regulations are necessary	- -	20 95%	1 5%

Table VII-8

PERCEIVED IMPORTANCE OF GENE BANKING

Base: Biotechnology scientists

Q.: Some scientists have argued that it is just as important to preserve natural genetic diversity through plant and animal gene banks as it is to create new genes in the lab. In your view, is gene banking of this sort very important, somewhat important, not very important, or not important at all?

	Total
Base	21
Very important	7 33%
Somewhat important	6 29%
Not very important	8 38%
Not important at all	- -
Not sure	- -

Table VII-9

STRINGENCY OF GOVERNMENTAL REGULATION OF BIOTECHNOLOGY IN THE YEAR 2000

Base: Biotechnology scientists

Q.: In the year 2000, do you expect governmental regulation of biotechnology to be much more stringent than today, slightly more stringent, about the same, slightly less stringent, or much less stringent than today?

	Total
Base	21
Much more stringent	- -
Slightly more stringent	4 19%
About the same	8 38%
Slightly less stringent	7 33%
Much less stringent	2 10%
Not sure	- -

Table VII-10

COST OF GENETICALLY-ENGINEERED INSULIN VS. INSULIN PRODUCED FROM ANIMAL SOURCES

Base: Biotechnology scientists

Q.: In the year 2000, do you think that genetically-engineered insulin will cost much more, somewhat more, somewhat less, or much less than insulin produced from animal sources?

	Total
Base	21
Much more	- -
Somewhat more	- -
About the same	3 14%
Somewhat less	5 24%
Much less	11 52%
Not sure	2 10%

Verbatims VII-4

THE MOST IMPORTANT FUNDAMENTAL QUESTION IN BASIC BIOTECHNOLOGY RESEARCH

Some Representative Quotes

Q.: As you know, advances in clinical medicine often result from fundamental advances in basic research. What do you think is the most important fundamental question which needs to be answered in order to achieve a major breakthrough in biotechnology?

"Those are the things that people are usually way off on. Who would have predicted 10 years ago we'd be sequencing DNA. I would say we'd like to understand development and the control of growth. It will have ramifications in cancer research, neurobiology, and many, many other areas."

"That is very hard to answer. There are many. The mechanisms of gene control and the problem of genetic control of gene expression."

"There are three fundamental important questions that must be attacked simultaneously:

1. What is the structure of the human genome (the linear sequence)?

2. How is gene expression regulated?

3. What are the rules for protein folding?"

"How genes work. We have to understand how they are regulated. When we answer questions like that the other answers will just fall out."

"I think that the most important question at the present time is how an organism develops cellular specificity and how cells communicate during morphogenesis. I think that molecular genentics will stay very important as a tool to investigate the questions of differentiation and intercellular communication."

Verbatims VII-5

THE MOST PROMISING APPLICATIONS OF BIOTECHNOLOGY TO ORGAN TRANSPLANTS AND MEDICAL TRANSPLANTS

Some Representative Quotes

Q.: Can you think of any applications for the field of biotechnology in organ transplants and medical transplants, or not?

Q.: What application do you think is most promising?

"First, the manipulation of an immune surveillance system. The second, to change the antigenic determinants of the organ being transplanted through genetic means -- so it is more histocompatible."

"Control of rejection phenomenon."

"We will see a new generation of effective anti-inflammatory drugs which will be used instead of the currently available immunosuppressive reagents."

"People still don't understand which cells in the host are involved in graft rejection. Biotechnology will be involved in answering that question."

"Using the products of biotechnology to react with T-cell receptors to control subpopulations of T-cells."

"If we knew what determined self/non-self, it might be possible to turn off the expression of donor transplantation antigens, and introduce transplantation antigens defined by the recipient."

"The production of biocompatible materials. The production of materials that can be placed into an animal that won't elicit a rejection reaction by the host's immune system."

"Gene transfer. Somatic introduction or introduction of cells which express the gene."

CHAPTER VIII: MEDICAL IMPLANTS IN THE YEAR 2000

The most important and most promising area of research for medical implants lies in the development of nonimmunogenic materials -- that is, materials which are not rejected by the body's immune system (Table VIII-1).

Scientists see important advances in the use of drug delivery systems such as implantable drug infusion systems and implantable pumps to deliver drugs (Table VIII-2 and Table VIII-3).

They are particularly optimistic about implants for the treatment of arthritis (91%), diabetes (87%), deafness (83%), hormonal defects (87%), and cardiovascular disease (82%) (Table VIII-2).

Artificial knees, hips, skin and blood are also seen as being much more widely used by the next century. Penile implants and bone banks will also be more widely used, they believe (Table VIII-3).

Animate vs. Inanimate Materials in the Use of Implants

A large majority (70%) believe that animate materials will replace inanimate materials in most or some implants by the year 2000 (Table VIII-4).

The Role of Implants

When asked to elaborate on the one area in which they see implants playing the greatest role in the year 2000, a majority of the specialists referred to orthopedics; the next most frequently mentioned was cardiovascular -- specifically heart valve implants and artificial heart replacements (Verbatims VIII-1).

The Use of Fetal Tissue for Human Transplants

Overwhelmingly, researchers believe that the use of fetal tissue for human transplants should be acceptable (91%) (Table VIII-5) and in fact will be acceptable (70%) by the year 2000 (Table VIII-6).

Table VIII-1

MEDICAL IMPLANTS: MOST PROMISING AREAS OF RESEARCH

Base: Medical implants scientists

Q.: I will read you a short list of some of the major areas of implant research. Please say for each one how promising you think it is on a scale of 0 to 10 where 0 is "not promising at all" and where 10 is "most promising one could imagine".

	Expected Degree of Promise					
	Rating Level on a Scale of 0 to 10					
Base: 23	Most Promising (9-10)	Promising (7-8)	Slightly Promising (5-6)	Not Promising (0-4)	Don't Know/ No Answer	Median
Suppression of immuno-genecity of biological tissues	10 43%	6 26%	4 17%	2 9%	1 4%	8
Suppression of immune response in the host	10 43%	5 22%	5 22%	3 13%	- -	8
Development of nonimmunogenic materials	7 30%	10 43%	1 4%	5 22%	- -	8
New animate, biological materials	7 30%	8 35%	5 22%	3 13%	- -	8
New inanimate, nonbiological materials	7 30%	7 30%	4 17%	5 22%	- -	8
Implants to restore hearing	7 30%	10 43%	4 17%	1 4%	1 4%	7
Methods to induce regeneration of existing tissue	7 30%	7 30%	4 17%	5 22%	- -	7
Electrical muscle stimulation to stimulate natural motion	2 9%	9 39%	6 26%	6 26%	- -	5
Electrical implants in the brain	1 4%	4 17%	7 30%	8 35%	3 13%	5
The use of fetal donors for replacement tissue	1 4%	3 13%	8 35%	11 48%	- -	5
Implants to restore vision	2 9%	3 13%	6 26%	11 48%	1 4%	4.5
The use of animal donors for replacement tissue	1 4%	3 13%	5 22%	14 61%	- -	2

Table VIII-2

THE USE OF IMPLANTS AND MEDICAL DEVICES: EXPECTED DEGREE OF ADVANCE BY THE YEAR 2000

Q.: How much of an advance you expect to see by the year 2000 in the use of implants and medical devices in the following?

Base: 23	A Great Deal	Quite a Lot	Not Much	None at All	Not Sure
Drug delivery	13 57%	8 35%	1 4%	- -	1 4%
The treatment of arthritis	12 52%	9 39%	2 9%	- -	- -
The treatment of cardiovascular disease	12 52%	7 30%	4 17%	- -	- -
The treatment of fractures	10 43%	6 26%	7 30%	- -	- -
The treatment of diabetes	8 35%	12 52%	1 4%	- -	2 9%
The replacement of individual blood vessels	8 35%	10 43%	4 17%	- -	1 4%
Limb replacement	6 26%	6 26%	9 39%	2 9%	- -
The treatment of burns	6 26%	8 35%	7 30%	- -	2 9%
The treatment of hormonal defects	6 26%	14 61%	1 4%	- -	2 9%
The treatment of kidney failure	6 26%	12 52%	4 17%	- -	1 4%
The treatment of deafness	5 22%	14 61%	4 17%	- -	- -
The treatment of the effects of aging	5 22%	8 35%	9 39%	1 4%	- -
The treatment of cancer	2 9%	11 48%	10 43%	- -	- -

(Continued)

Table VIII-2 (Continued)

THE USE OF IMPLANTS AND MEDICAL DEVICES:
EXPECTED DEGREE OF ADVANCE BY THE YEAR 2000

Base: 23	A Great Deal	Quite a Lot	Not Much	None at All	Not Sure
The treatment of blindness	2	4	16	-	1
	9%	17%	70%	-	4%
The treatment of spinal cord	1	4	15	3	-
or other nerve injury	4%	17%	65%	13%	-
The treatment of speech disorders	-	3	15	-	5
	-	13%	65%	-	22%
The treatment of muscular atrophies	-	1	20	1	1
such as ALS or muscular dystrophy	-	4%	87%	4%	4%

Table VIII-3

IMPLANTS AND MEDICAL DEVICES:
EXPECTED FREQUENCY OF USE BY THE YEAR 2000

Q.: I will read a list of actual or potential types of implants and medical devices. Would you please say for each one whether in the year 2000 it will be much more widely used than it is today, somewhat more widely used, less widely used, or whether it will scarcely be used at all.

Base: 23	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Implantable drug infusion system	16	6	1	-	-	-
	70%	26%	4%	-	-	-
Implantable pump to deliver drugs	13	5	3	-	1	1
	57%	22%	13%	-	4%	4%
Intraocular lens implant	12	3	5	-	-	3
	52%	13%	22%	-	-	13%
Bone bank	12	5	5	-	-	1
	52%	22%	22%	-	-	4%
Artificial blood	11	9	-	-	1	2
	48%	39%	-	-	4%	9%
Implantable hearing aid	10	9	2	-	-	2
	43%	39%	9%	-	-	9%
Artifical knee	10	11	2	-	-	-
	43%	48%	9%	-	-	-
Dental implant	9	10	4	-	-	-
	39%	43%	17%	-	-	-
Artifical hip	9	10	4	-	-	-
	39%	43%	17%	-	-	-
Artifical skin	9	12	-	1	-	1
	39%	52%	-	4%	-	4%
Artifical ankle	6	10	2	3	2	-
	26%	43%	9%	13%	9%	-
Artifical heart	6	9	2	3	2	1
	26%	39%	9%	13%	9%	4%

(Continued)

Table VIII-3 (Continued)

IMPLANTS AND MEDICAL DEVICES: EXPECTED FREQUENCY OF USE BY THE YEAR 2000

Base: 23	Much More Used	Somewhat More Used	Used as Often	Less Used	Scarcely Used	Not Sure
Penile implant	5 22%	11 48%	5 22%	1 4%	- -	1 4%
Artificial blood vessels	5 22%	14 61%	3 13%	1 4%	- -	- -
Artificial wrist	3 13%	15 65%	2 9%	2 9%	1 4%	- -
Implantable defibrillator	3 13%	14 61%	2 9%	2 9%	- -	2 9%
Artificial breasts	2 9%	9 39%	9 39%	- -	1 4%	2 9%
Pacemaker	2 9%	8 35%	9 39%	2 9%	- -	2 9%
Artifical toes and fingers	2 9%	6 26%	5 22%	- -	10 43%	- -
Artificial limb	1 4%	10 43%	9 39%	1 4%	2 9%	- -

Table VIII-4

WILL ANIMATE MATERIALS REPLACE INANIMATE MATERIALS BY THE YEAR 2000?

Base: Medical implants scientists

Q.: By the year 2000, to what extent do you think that animate materials will have replaced inanimate materials in the use of implants? In all, most, some or only a few implants?

	Total
Base	23
All	- -
Most	3 13%
Some	13 57%
A few	6 26%
None	1 4%
Not sure	- -

Verbatims VIII-1

THE ROLE OF IMPLANTS AND MEDICAL DEVICES IN THE YEAR 2000

Some Representative Quotes

Q.: In what one area do you see implants as playing the greatest role in the year 2000?

"Orthopedics ... Because it's an area in which a very big number of people are affected and it is an area where the problems are relatively easy to solve."

"Joint reconstruction. Treatment of muscular skeletal disease which affects artificial joints. In particular treatment of elderly patients with osteoarthritis."

"In the area of cardiovascular diseases. Because that is the area that most money goes into, and where most research concentrates. As a result it is (the) most advanced."

"Implantable drug delivery pumps."

"In artificial heart replacement."

"Heart valve implants."

"Cardiovascular -- such as artificial heart which can be used as an interim device supplement."

"It will still maintain its greatest use in orthopedics, followed by the cardiovascular field."

"Probably most prominently in the musculo-skeletal area. Cardiac implants will also play a big role."

"Joints and heart. Joint replacement will play the primary role."

"In orthopedic surgery, reconstructive surgery, and hearing aids. A walking machine for paraplegics. An improvement of the communications of crippled patients with their environment through lots of adapted devices."

Table VIII-5

SHOULD USE OF FETAL TISSUE FOR HUMAN TRANSPLANTS BE ACCEPTABLE BY THE YEAR 2000?

Base: Medical implants scientists

Q.: Do you think that the use of fetal tissue for human transplants should be acceptable?

	Total
Base	23
Should be acceptable	21 91%
Should not be acceptable	2 9%
Not sure	- -

Table VIII-6

WILL USE OF FETAL TISSUE FOR HUMAN TRANSPLANTS BE ACCEPTABLE BY THE YEAR 2000?

Base: Medical implants scientists

Q.: As you know, some promising animal experiments in tissue transplants have used tissue from fetal sources. This raises both ethical and scientific issues. Do you think that by the year 2000 it will or will not be acceptable to use fetal tissue for human transplants?

	Total
Base	23
Will be acceptable	16 70%
Will not be acceptable	7 30%
Not sure	- -

Table VIII-7

USE OF FETAL TISSUE FOR HUMAN TRANSPLANTS: EXTENT OF EFFECTIVENESS

Base: Medical implants scientists

Q.: If it were ethically acceptable to use fetal tissue for human transplants, do you think it will be very effective for treating a number of conditions, very effective for only a few conditions, or not very effective at all?

	Total
Base	23
Very effective for treating a number of conditions	2 9%
Very effective for treating a few conditions	19 83%
Not very effective at all	1 4%
Not sure	1 4%

Verbatims VIII-2

PROMISING AREAS OF IMPLANT RESEARCH

Some Representative Quotes

Q.: Is there any other major area of implant research which is more promising than those I have mentioned? If so, what is it?

"I think joint replacement. Research is important to arthritis and related conditions."

"Musculo-skeletal implants or transplants and joint replacement -- allografts as well as using nonbiologic materials."

"Development of spinal replacement. Insertion of spinal elements."

"Bioartificial organs which are really transplants of tissue protected against immunorejection by encapsulation in a semipermeable synthetic membrane. I think this is going to be a key to several organ transplants."

"The concept of implanting a material that begins as a purely mechanical device but by process of biodegradation and replacement ends as a biological device. There are a variety of approaches possible. The biological material could be induced to grow by the implantation of the mechanical device, or uncommitted cells could be co-implanted at the time of the mechanical implantation and those uncommitted cells could then be induced to differentiate while the mechanical device is being biodegraded."

"Prosthetic devices which will have biological control mechanisms. In essence those are biological feedback devices, e.g., cutaneous receptors could be hooked up to the prosthesis and send sensory information back to the nervous system. This way you can get motor control over an implant in essentially the same way as in an intact joint."

"I think an implantable infusion pump. There is hardly a chronic disease that you could imagine that couldn't use an implantable pump that would meter out a specific drug at a specific rate at a specific site."

"The replacement of soft tissue in the musculoskeletal system namely ligaments and tendons."

Verbatims VIII-3

THE MOST IMPORTANT FUNDAMENTAL QUESTION IN BASIC RESEARCH ON MEDICAL IMPLANTS

Some Representative Quotes

Q.: As you know, advances in clinical medicine often result from fundamental advances in basic research. What do you think is the most important fundamental question which needs to be answered in order to achieve a major breakthrough in the development and use of implants?

"I guess the most fundamental basic scientific question is the understanding of the stability of interaction between cells and artificial material. This could lead to a true incorporation of artificial material."

"... I would say: the control of the immune response to biological implants. There are many body parts that would be useful if we could suppress the immune response. If we were to do that we could eliminate much of the research on non-biological implants."

"The exact nature and control mechanisms of the process of immune rejection."

"Cell differentiation ... if you put an implant into the body you want a biological response, that is, cells need to differentiate. For instance, uncommitted cells have to differentiate into osteoblasts. This process is poorly understood and needs to be studied because it applies to all areas of implant research."

"Understanding factors which govern healing. Elucidation of mechanical environment optimum for fracture healing. If we know what the environment should be, we could plan appropriately."

"I think the material for implants have come a long way. The biggest frustration will be in achieving the permanent fixation and long-term durability of implants. The cellular level of understanding bone growth and bone fixation to implants has to be understood ..."

"The development of new inorganic artificial materials. Perhaps more important is to induce the natural biomaterial to grow -- for example, artificial tendons and ligaments. One theory is to make artificial cartilage grow by using natural material with some artificial material to act as scaffolding. This is a big problem for osteoarthritis."

"First of all we don't know why incidence of infection is about two times that of normal surgery. We don't know why bacteria survive. Infection is fatal in orthopedics and heart surgery. Until we know why, there will continue to be a problem."

Verbatims VIII-4

EXPECTED NEW IMPLANTS AND MEDICAL DEVICES IN THE YEAR 2000

Some Representative Quotes

Q.: What totally new type of implant do you foresee in the year 2000 that is not available today?

"A type of skeletal implant in which you connect the patient's bone directly to an artificial prosthesis. Instead of having to amputate a limb, close the wound and let it heal and then attach a prosthesis to the outside of the amputated limb in which you have a bone prosthesis directly interphased."

"I would guess it is going to be a fully implantable artificial heart. I mean one without the power unit outside of the body."

"I would think implantable pumps will be present in a highly sophisticated clinical form that doesn't exist yet. Cochlear and optical implants will be light years ahead from their present versions. Artificial hearts will be manyfold better than today. It is foreseeable that we will have artificial implantable livers made out of steel, rubber, and membranes. Also I think it is feasible that we will have artificial implantable kidneys that work in effect like the dialysis machine in use today but is miniaturized and completely implantable."

"Implanting control mechanisms for hormonal balance. Particularly for diabetes, parathyroid and growth disorders. These devices will not only deliver hormones from an injected site but they will also sense the physiological demands of the body and adjust the amount to be injected to those physiological demands. In other words it is a closed-loop feedback system."

"I think we are likely to see the replacement of menisci in the knee and ligaments as well. We will have synthetic anterior cruciate ligaments and the use of allografts for menisci and articular cartilage."

"One category of implants which uses a combination of live tissue and synthetic material at the time of implantation, e.g., will have biocardial patches to treat ventricle aneurisms. That is, in addition to the previously mentioned immune protected implants, we will have autologous tissue transplants -- tissue from patients grown outside of the body on a polymer matrix to achieve a particular shape or function and then reimplanted into the patient."

Verbatims VIII-5

ANIMATE VS. INANIMATE MATERIALS IN THE USE OF IMPLANTS BY THE YEAR 2000

Some Representative Quotes

Q.: Can you think of a specific instance where animate implants are likely to have replaced inanimate implants?

"Joint resurfacing. Currently allografts don't work particularly well. By the year 2000 we should have that problem solved and thus have allografts available for joint resurfacing."

"Probably the resurfacing of knee joints and similar joints by using allografts."

"I think the replacement of inanimate transplants of bone, skin and connective tissue by animate implants."

"... Most likely will be the implantation of insulin secreting tissue, either whole islets or islet cells or genetically engineered cell lines."

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